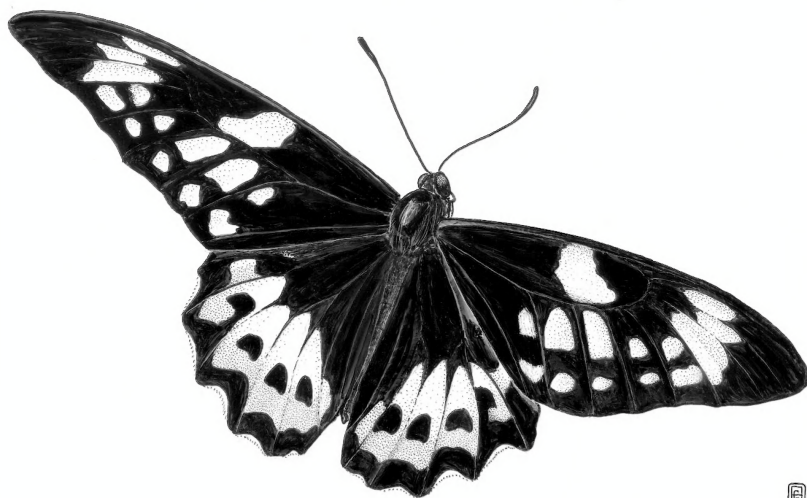


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A NEW SPECIES OF *ATARBA* OSTEN SACKEN FROM VICTORIA, AUSTRALIA (DIPTERA: LIMONIIDAE)

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Abstract

Atarba (Ischnothrix) archi **sp. n.** is described from the Yarra Ranges of Victoria, Australia. Its affinity with the 13 other known Australian species of *Atarba* Osten Sacken is discussed.

Introduction

The crane fly genus *Atarba* Osten Sacken, 1869 is distributed across all continents except Antarctica and is most diverse in the Neotropical Region. Of the three subgenera and 160 described species of *Atarba* only 13 species, all in the subgenus *Ischnothrix* Bigot, 1888, have been recorded previously from Australia (Oosterbroek 2019); other *Ischnothrix* species are known from South America (30) and New Zealand (4) (Ribeiro and Eterovic 2011).

The first Australian species of *Atarba*, *A. (I.) australasiae* and *A. (I.) lawsonensis*, were described by Skuse (1890), who placed them in the genus *Limnophila* Macquart, 1834 but recognised that they formed a natural grouping and likely constituted a distinct subgenus of *Limnophila*, if not an entirely separate genus in their own right. Alexander (1922) described *A. (I.) generosa*, placing it in the genus *Rhabdomastix* Skuse, 1890, then (Alexander 1929, 1931) described *A. (I.) verticalis*, *A. (I.) grampiana* and *A. (I.) mathewsi*, placing them in *Ischnothrix*. Theischinger (1994) revised the six known Australian species and described an additional six species, *A. (I.) augusta*, *A. (I.) iyouta*, *A. (I.) millaamillaa*, *A. (I.) thowla*, *A. (I.) waylehmina* and *A. (I.) williamsi* as new, then (1996a) described a further species, *A. (I.) bickeli*, as new. The present paper adds to the knowledge of the Australian fauna by describing a newly discovered species, thus elevating the total number of known Australian *Atarba* species to fourteen.

The new species, *Atarba (Ischnothrix) archi* **sp. n.**, was discovered during surveys of the crane flies of Victoria undertaken by the first author. It is known only from a single location in the Yarra Ranges (Fig. 1), along the banks of a small upland stream (Fig. 2).

The key provided by Theischinger (1996b) aids greatly in distinguishing *Atarba* from other limoniid genera. In conjunction with the key to species groups of *Atarba* given by Theischinger (1994) and the descriptive notes below, *Atarba (Ischnothrix) archi* **sp. n.** can be readily distinguished from similar species.



Figs 1-2. *Atarba (Ischnothrix) archi* sp. n.: (1) known distribution; (2) type locality - Cumberland Creek by Marysville-Woods Point Rd, Victoria.

Materials and methods

Specimens were collected by sweeping a hand net through vegetation and then preserved in 100% ethanol. As a result of this preservation, the coloration of specimens might have changed from the natural state. The illustrations of the male genitalia (hypopygium) are from specimens cleared in KOH and examined in glycerol.

Specimens have been deposited in the Museum Victoria (NMV) collection. Those retained by the first author are kept in a vouchered research collection at the Gutteridge, Haskins & Davey (GHD) water sciences laboratory in Melbourne to aid in ongoing survey work and for use in DNA barcoding studies. DNA sequencing efforts are ongoing; sequence and specimen data are stored in the Barcode of Life Data Systems (BOLD) database and, upon any future publication of genetic data, sequences will be made available from GenBank.

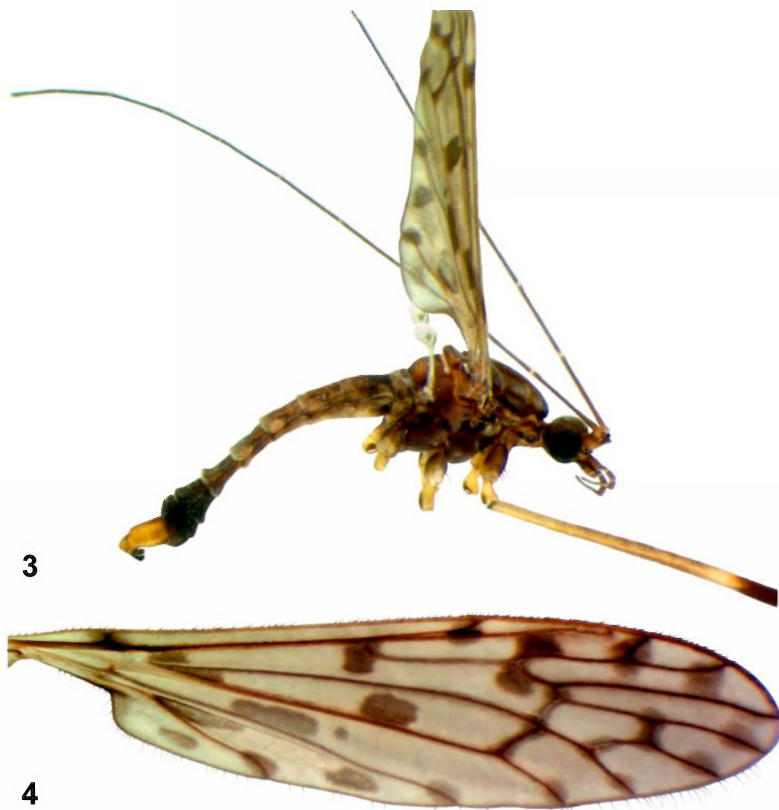
Descriptive terminology is in accord with McAlpine (1981).

Abbreviations used in Figure 6: *ae*, aedeagus; *iea*, inner element of aedeagal complex; *ig*, inner gonostylus; *lea*, lateral element of aedeagal complex; *og*, outer gonostylus.

Atarba (Ischnothrix) archi sp. n.

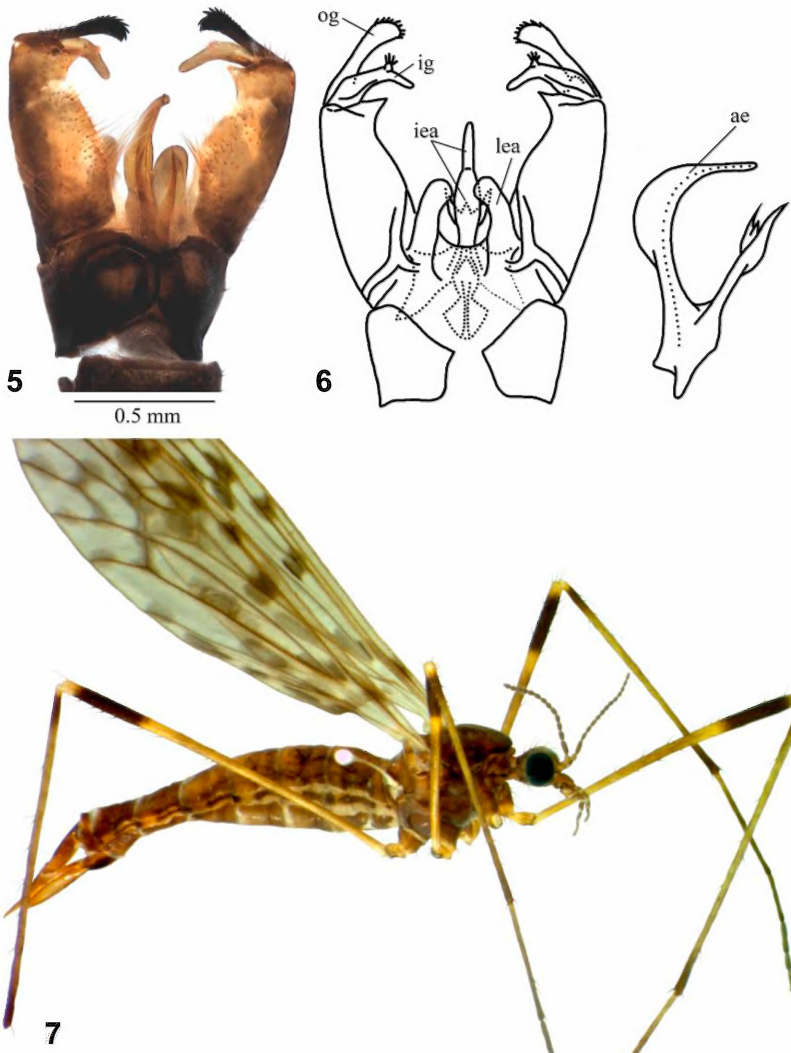
(Figs 3-8)

Material examined. Holotype ♂, VICTORIA: Cambarville, Cumberland Creek off Cumberland walk by Marysville-Woods Point Rd (-37.556°S, 145.879°E), 20 Dec 2013, Z. Billingham, NMV (T22442). *Paratypes*: 1 ♂, 2 ♀♀, same data as holotype, NMV (T22443-T22445); 2 ♂♂, 2 ♀♀, same data as holotype, GHD (T8941- T8942, T8944-T8945).



Figs 3-4. *Atarba (Ischnothrix) archi* sp. n., male: (3) general habitus; (4) wing.

Description. Male (Figs 3-6): body length 8.9 mm, wing length 9.2 mm. Head dark greyish brown, antennal scape and pedicel golden brown, otherwise dark greyish brown, palpus dark greyish brown with terminal segment whitish grey. Antenna elongate, 13.7 mm long, greatly exceeding body length. Antennal scape broadly expanded, flagellar segments elongate cylindrical, particularly the basal segments, segments becoming less elongate towards the apex. Pronotum, prescutum, scutum, scutellum and mediotergite dark brown, with light silver-grey pruinosity. Pleurae dark brown, with light silver-grey pruinosity. Forecoxa yellowish brown, mid- and hindcoxa dark brown. Trochanters yellowish brown. Basal 2/3 of femora greyish brown, followed by a narrow yellowish brown ring, a broad dark brown ring and a narrow apical yellowish brown ring. Tibiae greyish brown with tip darkening to brownish black. Tarsal segments greyish brown darkening to black.



Figs 5-7. *Atarba (Ischnothrix) archi* sp. n.: (5-6) male, hypopygium: (5) ventral view; (6) dorsal view, with lateral view of inner element of aedeagal complex inset; (7) female, general habitus.

Wing (Fig. 4) tinged pale grey with extensive pattern of dark markings consistent with many species of Australian *Atarba*; a dark marking at the marginal end of all subcostal, radial, medial and anal veins, additional dark

markings at the origin and fork of Rs, along m-cu, in the centre of cells bm and cup, at the base and margin of a1 and the margin of a2. Haltere with stem pale grey and knob whitish.

Abdomen greyish brown, terminal segments darkening to black. Hypopygium (Figs 5-6) golden brown, in general form typical of Australian *Atarba*. Inner gonostylus distinctly bent at about 2/3 its length, a setose lobule on dorsal surface above the bend. Lateral elements of the aedeagal complex (parameres) convergent. Inner element of aedeagal complex comprising two parts, a dorsal elongate, strongly arched, medially dilated and apically narrowed structure (aedeagus) and a ventral structure bearing three terminal prongs, the lateral prongs longer and sharper than the medial prong.

The male paratypes do not differ significantly from the holotype.

Female (Fig. 7): colour much as in male; body length 9.0 mm, wing length 8.5 mm. Antenna much shorter than in male, extending back only to the transverse suture, scape cylindrical, flagellar segments short cylindrical to ovoid. Ovipositor with apex of hypogynial valve reaching to about 3/4 length of cercus (Fig. 8).



Fig. 8. *Atarba (Ischnothrix) archi* **sp. n.**, female, ovipositor, lateral view.

Discussion. The heavily patterned wings, the distinctly bent inner gonostylus with setose lobule at bend and lacking basal lobe, and the convergent lateral elements of the aedeagal complex place *A. (I.) archi* **sp. n.** in the *A. (I.) lawsonensis* group of species (Theischinger 1994). Of these species, *A. (I.) archi* **sp. n.** is most similar to *A. (I.) waylehmina*; however, the male differs in the greatly elongate antennae and the strongly arched dorsal structure of the inner element of the aedeagal complex (aedeagus).

Etymology. This species is named in memory of Archibald “Arch” Rowan, for his support of the first author.

Acknowledgements

Specimens collected from protected areas were done so under Victoria Department of Environment and Primary Industries permit number 10006838. We wish to thank John Martin (Australian Museum) for assistance with a photograph of the hypopygium. Gutteridge, Haskins & Davey (GHD Pty Ltd) natural resources team is highly appreciated for their support of the first author's studies.

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THRIPS (THYSANOPTERA) OF THE AUSTRALIAN TERRITORY OF CHRISTMAS ISLAND, INDIAN OCEAN

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Abstract

Twelve species of Thysanoptera in three families (Merothripidae, Thripidae and Phlaeothripidae) are here recorded from the Australian Territory of Christmas Island. These are all known from Southeast Asia, with eight of them also known from the Australian mainland. Nine of the species feed on fungi on dead branches, the other three being phytophagous.

Introduction

The Territory of Christmas Island, situated 360 km south of Java and 1400 km north-west of Australia, has a land area of about 135 km². The Australian Biological Resources Study includes within the Australian Faunal Directory [<https://biodiversity.org.au/afd/home>] any published records of organisms from Christmas Island, but distinguishes these from the Australian mainland records by listing them under the heading 'Other Regions'. A recent search of the AFD site for records of insects from Christmas Island generated a list of 166 species, of which only three are members of the Order Thysanoptera. The insect fauna on the Australian Overseas Territories is of continuing interest to the Australian Quarantine Service, in view of the frequency of air communication.

The notes presented here are to put on record the thrips species in the Australian National Insect Collection, CSIRO, Canberra, that have been collected on Christmas Island. There has been no survey of the island targeting Thysanoptera but, in October 1990, the CSIRO Entomology Division produced for the Australian National Parks and Wildlife Service a 70-page unpublished report (available at CSIRO Library, Black Mountain, Canberra). This was a consultancy report on a general entomological survey of Christmas Island in April 1989 by three CSIRO staff from Canberra. The Thysanoptera they collected were sent to the Natural History Museum, London and page 23 of the report states that between 25 and 30 species were found in the collection. Slide mounts were not prepared of these specimens; therefore no reliable identifications could be produced. However, based on low-power observations in ethanol, seven genera of phytophagous Thripidae and 14 genera of mycophagous Phlaeothripidae were listed as being represented, all of which are widespread in the Asian tropics. All such thrips specimens in ethanol were disposed of by the Natural History Museum when the insect collections were moved to a new building in 2005. Then, in April 2019, Tony Postle visited Christmas Island and, through insecticide fogging of vegetation and dead branches together with some leaf litter extractions, collected a number of thrips. These have been slide mounted and the 12 Thysanoptera species now identified from Christmas Island are listed below.

Several of these are widespread tramp species and eight of the 12 are known from the Australian mainland. Concerning their biology, nine of these species are fungus-feeders, with only three phytophages. Full nomenclatural details of all these species are available at ThripsWiki (2019), together with many detailed images. Christmas Island is referred to below as CI.

Species recorded

MEROTHRIPIDAE

***Merothrips indicus* Bhatti & Ananthakrishnan, 1975.** Described from two sites in southern India based on two female macropterae and one male aptera, this species was distinguished from the worldwide *M. floridensis* Watson, 1927 by the precise position of a single pair of setae on tergites II-VI in macropterous females. This character state was first used to distinguish species in this genus by Mound and O'Neill (1974) but, although apterae of *M. floridensis* are widespread and sometimes abundant, including in eastern Australia, macropterae are too rare for statistically satisfactory comparisons. Several winged females that appear to share the tergal chaetotaxy described for *M. indicus* were collected on CI at four separate sites in April 2019 but the significance of this species as distinct from *M. floridensis* remains in doubt. As with other members of the family Merothripidae, this thrips lives on dead branches and feeds on fungal hyphae.

THRIPIDAE

***Copidothrips octarticulatus* (Schmutz, 1913).** Described from Sri Lanka, this is a typical leaf-feeding species of Panchaetothripinae. It is presumably established on CI because it was collected in both 1989 and 2019, but it is recorded widely from the Seychelles to northern Australia and also islands in the Pacific Ocean. In these countries it has been collected from the leaves of various unrelated plant species with no apparent host specificity (Mound *et al.* 2012).

***Megalurothrips typicus* Bagnall, 1915.** Members of this genus all breed in the flowers of various species of Fabaceae and are particularly associated with bean crops (Mound *et al.* 2012). A single female was collected on CI in 1989 and the species is widespread in Southeast Asia.

***Trichomothrips priesneri* (Bhatti, 1967).** Described from India, females of this species have been studied from Thailand and Hawaii (Mound *et al.* 2017). It is probably associated with one or more species of Cyperaceae and two females were collected on CI in April 2019.

PHLAEOTHRIPIDAE

***Apelaunothrips madrasensis* (Ananthakrishnan, 1964).** Described from India, this fungus-feeding species of Phlaeothripinae is also known from Japan, Malaysia and Java (Okajima 2006). A single female was collected on CI in April 1989.

***Ecacanthothrips tibialis* (Ashmead, 1905).** This highly variable species of Phlaeothripinae is widespread from India to southern Japan, New Guinea and northern Australia (Palmer and Mound 1978). A fungus-feeding species that lives on dead branches, a single female was collected on CI at light in April 1989.

***Ethiorthrips stenomelas* (Walker, 1859).** This large, dark brown spore-feeding thrips of subfamily Idolothripinae has been found widely in the Old World tropics and subtropics (Okajima 2006). It breeds on dead branches, and a single female was collected on CI during April 2019.

***Hoplandrothrips flavipes* Bagnall, 1923.** Widespread throughout tropical countries, this is another fungus-feeding species that lives on dead branches (Mound and Tree 2013). A single female was collected on CI in April 1989 in a malaise trap.

***Nesothrips lativentris* (Karny, 1913).** This is another large, dark species of Idolothripinae that is widespread in countries between the Indian Ocean and Fiji, including northern Australia (Eow *et al.* 2014). It lives on dead branches and feeds on fungal spores. A single female was collected on CI in April 1989.

***Pygmaeothrips angusticeps* (Hood, 1908).** Although described originally from Illinois, USA, this Phlaeothripinae species has been described under six other names from Hawaii, northern Australia, Indonesia, Japan and several parts of South America (Okajima 2006, ThripsWiki 2019). A substantial breeding colony that included winged and wingless adults as well as numerous larvae was recovered by insecticide fogging of a dead branch on CI in April 2019.

***Stephanothrips adnatus* Ananthakrishnan, 1972.** Described from northern India and subsequently recorded from Nepal, females of this wingless species were collected in leaf litter on CI at several sites in April 2019. A fungus-feeding member of the Phlaeothripinae: Urothripini, it is unusual among its congeners for having the two lateral pairs of setae on the anterior margin of the head very short and fan-shaped (Kudo 1989).

***Stephanothrips occidentalis* Hood & Williams, 1925.** This wingless species is widespread in tropical countries around the world and has been collected commonly in northern Australia (Mound and Tree 2018). A single female was collected on CI in April 2019.

Acknowledgements

With many thanks to Tony Postle for his continuing enthusiasm and help in studies on Australian thrips; also to Geoff Monteith and two reviewers for their comments on an initial draft.

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NEW RECORDS OF *EUPLOEA ALCATHOE MONILIFERA* MOORE, 1883, STAT. REV. (LEPIDOPTERA: NYMPHALIDAE: DANAINAE) FROM CAPE YORK PENINSULA, QUEENSLAND, AUSTRALIA

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Abstract

New records of *Euploea alcatheae* (Godart, [1819]) from western Cape York Peninsula are presented. These specimens are illustrated and compared with other specimens of *E. alcatheae* from Australia and, based on adult morphology, are treated as *E. a. monilifera* Moore, 1883, stat. rev.

Introduction

Euploea alcatheae (Godart, [1819]) ranges from Buru in southern Maluku, the Aru Archipelago, Numfoor, Japen, mainland New Guinea and adjacent islands of Papua New Guinea to northern Australia (Parsons 1998, Braby 2000, Lambkin *et al.* 2019). Three subspecies have been recognised historically in Australia – *E. a. monilifera* Moore, 1883, described from Thursday Island and subsequently considered from Torres Strait and Cape York but later excluded from the Australian fauna (Waterhouse and Lyell 1914, Lambkin & Knight 1990, Braby 2000, Lambkin 2001); *E. a. misenus* Miskin, 1890 from Cape York and subsequently considered from Torres Strait (Lambkin 2005, Braby 2016, Lambkin *et al.* 2019); and *E. a. enastri* Fenner, 1991 from the Gove Peninsula in northeastern Arnhem Land, Northern Territory (Fenner 1991, Braby 2009, Lambkin *et al.* 2019).

The recent discovery of populations of *E. alcatheae* on the west coast of Cape York Peninsula (between Mapoon and Weipa along the Wenlock River system) provides new insight into the taxonomic status and verification of the original record of *E. a. monilifera* from Thursday Island.

Abbreviations of specimen depositories are: CEMC – C.E. Meyer collection, Brisbane; CGMC – C.G. Miller collection, Lennox Heads; DALC – D.A. Lane collection, Atherton; RDHC – R.D. Ham collection, Bayview Heights; RPWC – R.P. Weir Collection, Bees Creek; and SSBC – S. S. Brown Collection, Bowral. Abbreviations of collectors are: AIK – A.I. Knight; CEM – C.E. Meyer; CGM – C.G. Miller; DAL – D.A. Lane; DNW – D.N. Wilson; RDH – R.D. Ham; RPW – R.P. Weir; and SSB – S.S. Brown.

On the type of *Euploea alcatheae monilifera*

The taxonomic treatment of *E. alcatheae* in Australia has historically contained elements of uncertainty (Lambkin 2005, Lambkin *et al.* 2019), due in part to a paucity of available specimens. *Euploea a. monilifera* Moore, 1883 was historically regarded as the correct subspecies name for specimens from Queensland, with Waterhouse and Lyell (1914) including it in their revisionary monograph and treating *E. a. misenus* Miskin, 1890 from Cape

York as a junior synonym. Waterhouse and Lyell (1914: pl. 3, fig. 22) illustrated the type female of *E. a. monilifera* from Thursday Island, as reproduced from a coloured drawing of the type in the British Museum of Natural History (now the Natural History Museum), as well as illustrating Miskin's male of *E. a. misenus* Miskin, 1890 from Cape York (Waterhouse and Lyell 1914: pl. 2, fig 14), held in the Queensland Museum, and stated by Waterhouse and Lyell to probably be the Miskin (1890) type specimen, although not labelled as such. It was regarded as a syntype by Hancock (1995) and holotype by Lambkin *et al.* (2019), who also illustrated it. Waterhouse and Lyell (1914) also cited a second male specimen in their collection from Thursday Island. D'Abrera (1971), Common and Waterhouse (1972) and Lambkin (2001) also treated Australian specimens as *E. a. monilifera*, listing the known distribution as northern Cape York Peninsula and Torres Strait islands. Fenner (1991) later described *E. a. enastri* from northeastern Arnhem Land in the Northern Territory.

In a review of *E. alcaethoe* in Torres Strait, Lambkin (2005) proposed that the subspecies *E. a. misenus* should be the appropriate subspecific name for *E. alcaethoe* populations in Torres Strait and Cape York, based on the premise that the type female of *E. a. monilifera* was incorrectly labelled and did not come from Thursday Island. This specimen (as illustrated in Waterhouse and Lyell 1914) has fairly extensive white spotting on both fore- and hindwing uppersides and, based on these markings, the specimen was considered by Lambkin (2005) to more likely belong to subspecies *E. a. nox* Butler, 1866 from Aru, as it did not closely match any other known female specimens from Torres Strait in size and extent of white markings.

In a further review of *E. alcaethoe*, Lambkin *et al.* (2019) again concluded that the female type specimen of *E. a. monilifera* was incorrectly labelled, that the name *monilifera* was not the correct name for Thursday Island and Cape York specimens and formally synonymised *E. a. monilifera* with *E. a. misenus*.

The recent collection and observation of specimens from an apparently resident population of *E. alcaethoe* in western Cape York Peninsula, including females that bear extensive white spotting on both fore- and hindwing upper surfaces, gives reason to re-examine the validity of the Thursday Island type female and thus the validity of the name *E. a. monilifera* as applied to Cape York and southern Torres Strait specimens.

Observations

On 9 July 2018, one of us (RDH) collected a single male (Figs 1-2) at Batavia Landing (12°10'38.6"S, 141°53'46.0"E), off the Weipa-Mapoon Road on the Wenlock River, Cape York Peninsula. The butterfly was feeding on the flower of an unidentified weed along the edge of monsoon vine thicket adjacent to the Wenlock River. At this location, a narrow (approx. 10 m wide) strip of mangroves is backed by a narrow belt of paperbarks to 30 m tall, with a mosaic of monsoon vine thicket and open woodland farther from

the river. Other species observed were *E. corinna* W.S. Macleay, 1826, *E. sylvester sylvester* (Fabricius, 1793) and *E. darchia niveata* (Butler, 1875), which were all seen flying or roosting in the rainforest and paperbark swamp environs.

On 17 October 2019, DAL collected 1 female and 2 males and observed a second female within a stretch of wet gallery rainforest, at an unnamed gully that acts as a small tributary of the Wenlock River at 12°20'20"S, 141°55'03"E (hereafter referred to as site 2). A third male was observed but not collected on 18 October 2019. At site 2 (some 18 km south of Batavia Landing), observed adults flew at approx. 2-4 metres above ground level and appeared extremely wary of capture, flying directly away at rapid speed when approached. Other species collected and observed at site 2 were *E. corinna* and *E. eichhorni* Staudinger, 1884. Conditions during 17-18 October 2019 in the Mapoon area were extremely dry and the Batavia Landing area produced no sign of *E. alcaethoe*. Site 2 was found to be a much wetter area, with numerous soaks supporting intermittent waterpools above high tide level. Both Batavia Landing and site 2 are adjacent to the Wenlock River system, which undergoes very large shifts in tide levels. Mangrove forest dominates the tidal range, with gallery rainforest and tall paperbark forest straddling adjacent areas separating dry eucalypt woodland on the peripheral higher areas. Similar areas are widespread throughout the Wenlock River system and further discussion is presented about the species' potential distribution.

Material examined

Euploea alcaethoe monilifera Moore, 1883. QUEENSLAND: 1 ♂, Batavia Landing, 12°10'38.6"S, 141°53'46.0"E, 09.vii.2018, RDH [42 mm] (in RDHC) (Figs 1-2); 2 ♂♂, 1 ♀ (Figs 7-8), Un-named Gully, Wenlock River, 12°20'20"S, 141°55'03"E, 17 October, 2019, DAL [female forewing length 44.5 mm, males 45, 44 mm] (in DALC); Type ♀ image, 'Thursday I.' (Waterhouse and Lyell 1914: pl. 3, fig. 22).

Euploea alcaethoe misenus Miskin, 1890. QUEENSLAND (TORRES STRAIT): 1 ♂, Saibai I., 19-20.iv.2001, CEM & SSB [forewing length 43 mm]; 2 ♀♀, same data [42, 44 mm]; 1 ♂, same data except 03-04.v.2002 [45 mm] (Figs 5-6); 1 ♀, same data [44 mm]; 1 ♂, Dauan I., 11-17.iv.2001, CEM & SSB [42.5 mm]; 3 ♀♀, same data [43, 45, 43 mm]; 5 ♂♂, Dauan I., 26.iv-02.v.2002, CEM, SSB & RPW [44, 45, 44, 42.5, 41 mm]; 1 ♀, same data [44 mm]; 1 ♂, Dauan I., 06-13.iv.2017, CEM, SSB, RPW & CGM [42.5 mm]; 1 ♀, same data except 14-19.i.2017 [46.5 mm]; 1 ♀, Darnley I., 11.i.2006, AIK [42 mm] (in CEMC); 1 ♀, Dauan I., 16-20.iv.2015, SSB, CEM, RPW, CGM, [49 mm]; 1 ♀, Dauan I., 7-14.i.2011, SSB & CEM, [49 mm]; 1 ♀, Dauan I., 13-19.iv.2001, SSB & CEM [44.5 mm] (in SSBC); Type ♂ image, 'Cape York' (Waterhouse and Lyell 1914: pl. 2, fig. 14; Lambkin *et al.* 2019).

Euploea alcaethoe enastri Fenner, 1991. NORTHERN TERRITORY: 2 ♂♂, Gove, ii.1990, DNW [forewing length 45, 43 mm]; 1 ♀, same data [45 mm] (in CEMC); 1 ♂, Gove, ii.1990, DNW (Figs 3-4) [45 mm]; 1 ♀ same data (Figs 11-12), [53 mm] (in SSBC); 1 ♂, Rocky Bay, Gove, 7.v.1992, CGM [45 mm]; 1 ♂, same data except 6.v.1992 [41 mm] (in CGMC); 3 ♂♂ Gurrumururu, 150 km SW of Nhulunbuy, 11.iv.2003, RPW [41, 43, 46 mm] (in RPWC).

***Euploea alcaethoe monilifera* Moore, stat. rev.**

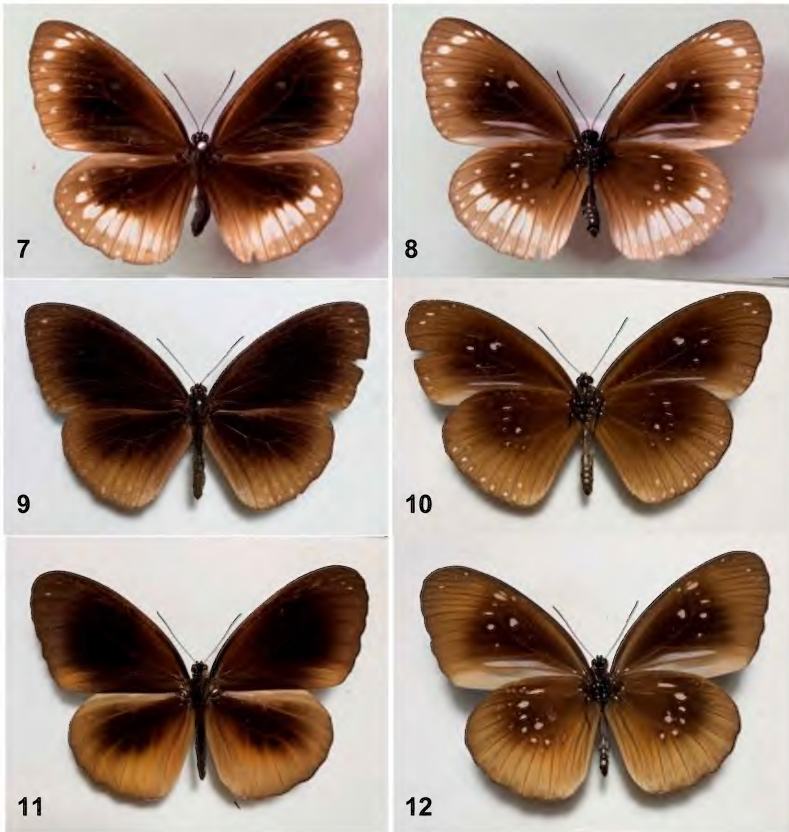
(Figs 1-12)

Euploea alecto monilifera Moore, 1883: 252-253 (type locality Thursday Island).

Euploea alcaethoe monilifera Moore: Carpenter 1953: 91.



Figs 1-6. *Euploea alcaethoe* males, upper and undersides: (1-2) *E. a. monilifera*, Batavia Landing, Qld, 09.vii.2018, RDH [forewing length 42 mm] (in RDHC); (3-4) *E. a. enastri*, Gove, NT, ii.1990, DNW [45 mm] (in SSBC); (5-6) *E. a. misenus*, Saibai Island, Torres Strait, Qld, 03-04.v.2002 CEM, SSB & RPW [45 mm] (in CEMC).



Figs 7-12. *Euploea alcatheae* females, upper and undersides: (7-8) *E. a. monilifera*, 18 km S of Batavia Landing, Cape York Peninsula, Qld, 17 October 2019, DAL [FW length 44.5 mm] (in DALC); (9-10) *E. a. enastri*, Gove, NT, ii.1990, DNW [53 mm] (in SSBC); (11-12) *E. a. misenus*, Dauan Island, Torres Strait, Qld, 7-14 January 2011, SSB & CEM [49 mm] (in SSBC).

The forewings of the Batavia Landing and site 2 males lack a sex brand, have a strongly bowed dorsum and have many of the morphological characters of *E. alcatheae* noted by Lambkin *et al.* (2019). Comparison with descriptions and images in Fenner (1991), Braby (2000), Lambkin *et al.* (2019) and with specimens in private collections (RDHC, DALC, CEMC, SSBC, CGMC, RPWC), indicated that these males are generally more similar to *E. a. enastri* (Figs 3-4) than to *E. a. misenus* (Figs 5-6). Fenner (1991) separated *E. a. enastri* from *E. a. misenus* by the submarginal spots on the dorsal surface of

the hind wing being either very small or only obscurely indicated. The hindwing submarginal spotting of the Batavia Landing and one of the site 2 males is much more pronounced than in specimens of *E. a. enastri* held in CEMC, CGMC and RPWC, but the second male from site 2 more closely resembles the male in SSBC (Figs 3-4). The three males from Batavia Landing and site 2 are unlike any males of *E. a. misenus* examined (e.g. Figs 5-6), which lack the hindwing white spots.

The collected female (Figs 7-8) and the second observed female from site 2 show quite large and extensive areas of white spotting on the fore- and hindwing upper surfaces, even slightly more extensive than in the Thursday Island type female of *E. a. monilifera*. The site 2 female has much larger white hindwing submarginal spotting than all examined females of *E. a. misenus* (e.g. Figs 11-12) and *E. a. enastri* (e.g. Figs 9-10) and is readily separable. It is closest to the type female of *E. a. monilifera* as illustrated in Waterhouse and Lyell (1914) but has even larger and more pronounced hindwing white spotting than the type.

The close similarity of the site 2 distinctive female with the type female of *E. a. monilifera* from Thursday Island (figured by Waterhouse and Lyell 1914), provides strong evidence that its type locality, Thursday Island, is correct and is here accepted as being accurate. It follows that subspecies *E. a. monilifera* should be recognised as a distinct subspecies, the females differing from other *E. alcaethoe* subspecies as discussed above. Therefore, it is hereby reinstated. Differences between males from Batavia Landing and site 2 and those of *E. a. misenus* from northern Torres Strait islands gives added support to recognition of *E. a. monilifera* as occurring on Thursday Island and northern Cape York Peninsula.

It appears logical that northern Torres Strait island populations of *E. alcaethoe* would have a strong affinity with populations in southern Papua New Guinea, as determined by Lambkin *et al.* (2019), and supports recognition of subspecies *E. a. misenus* as occurring in northern Torres Strait and southern Papua New Guinea. With the recognition of Thursday Island and western Cape York Peninsula populations (= *E. a. monilifera*) as distinct, similar populations might occur on other southern Torres Strait islands, including Horn, Hammond and Muralag (Prince of Wales) Islands and perhaps elsewhere on Cape York Peninsula.

Lambkin (1991) described and illustrated the life history of *E. alcaethoe misenus* from Boigu Island, northern Torres Strait, and recorded the foodplant as *Gymnanthera oblonga* (Burm.f.) P.S. Green (Apocynaceae). This plant is found in northern Cape York Peninsula (CSIRO 2010, Kew Science 2017) but was also observed in the vicinity of site 2. Braby (2009) recorded *Parsonsia alboflavescens* (Dennst.) Mabb (Apocynaceae) as the foodplant for *E. a. enastri* in the Northern Territory but this plant is not recorded from northern Cape York Peninsula.

Distribution

Populations of *E. a. monilifera* on Cape York Peninsula are currently known from the original Thursday Island specimen of Moore (1883) and from specimens recorded here from Batavia Landing and an un-named gully some 18 km further south. These two localities lie adjacent to the Wenlock River due south of the river's mouth, between Mapoon and Weipa on the west coast of Cape York Peninsula. A review of the area suggests that there are numerous other potential sites where the species could occur along parts of the Wenlock River where suitable habitat exists; thus the known distribution is expected to increase in size in areas between Mapoon and Weipa. The species might occur north of Mapoon and south of Weipa in suitable areas adjacent to the coast and river systems.

Miskin's (1890) type of *E. a. misenus*, labelled 'Cape York', possibly represents a vagrant from further north in Torres Strait or Papua New Guinea. Similarly, Moore's (1883) type of *E. a. monilifera* from 'Thursday Island' might have originated in western Cape York Peninsula.

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HEMICORDULIA ARMSTRONGI SP. N. (ODONATA: ANISOPTERA: CORDULIIDAE) FROM NEW ZEALAND

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Abstract

The dragonfly previously recognised from New Zealand under the name *Hemicordulia australiae* (Rambur, 1842) is described as a new taxon, *Hemicordulia armstrongi* **sp. n.** on the basis of morphological differences in both adults and larvae, as well as adult behavioural differences. Photographic evidence requiring confirmation is presented suggesting that the species might co-occur with *H. australiae* in Australia and that *H. australiae* also might occur in New Zealand.

Introduction

Around the beginning of the 20th century a *Hemicordulia* Selys species began to be collected in New Zealand (Hudson 1950, Armstrong 1978, Rowe 1987). Tillyard (1917), in characterising the odonate fauna of Norfolk Island (750 km NW of New Zealand), commented on the presence of *Hemicordulia australiae* (Rambur, 1842) and noted that specimens represented the darker, northern form: ‘The specimens are dark like those recorded from the Kermadec Islands. In Australia, this species ranges along the eastern coast from Victoria to Queensland, becoming darker as it goes north’. The Kermadec Islands lie 1050 km NE of New Zealand. Earlier (Tillyard 1912), he had referred to the Kermadec material as ‘a dark and handsome form, practically identical in size and colouring with the specimens found in the Sydney district’. Later (Tillyard 1926), he commented on the presence of *H. australiae* in New Zealand but without mentioning the source of any material.

Tillyard’s determination was accepted uncritically within the New Zealand literature (e.g. Armstrong 1958, Fraser 1960, Penniket 1966, Wise 1977, Rowe 1987, Marinov and Ashbee 2019). When visiting New Zealand in 1979, Australian odonatan specialist J.A.L. Watson commented in passing to Rowe and Philip S. Corbet that there was something anomalous about New Zealand examples of *H. australiae* he had seen in the field; however, he was unable to identify what was troubling him. This observation was reported by Rowe (1981a) and the species was designated there as *H. ‘australiae’*. Winstanley and Brock (1983), considering *H. australiae* in the New Zealand region, recorded that larvae from Norfolk Island had a well-formed mid-dorsal crest of strong spines, consistent with Australian descriptions of larvae (e.g. Watson 1962), but differing from descriptions of New Zealand larvae, which lack the median spines (Penniket 1966, Rowe 1981b). Winstanley and Brock (1983) figured the difference in form. In New Zealand the absence of mid-dorsal protuberances was reported as a character distinguishing larval *H. australiae* from those of *Procordulia smithii* (White 1846) (e.g. Penniket

1966, Rowe 1987). Australian descriptions of larvae were consistent and between them Armstrong and Rowe had examined over a thousand exuviae from New Zealand without ever noticing a mid-dorsal ridge of spines. Winstanley (1983) further drew attention to patterns of wing saffronation (yellowing) seen in Australian, Norfolk Island, Kermadec Island and Mayor Island (a small islet 4 km in diameter 30 km off the east coast of NZ North Island) female specimens in contrast to the hyaline (clear) wings of material from New Zealand. On the basis of the distinct larval forms and female wing coloration, Winstanley postulated that two separate species might be involved.

Rambur's description (1842) of male and female *H. australiae* is very complete and a photograph of an original syntype from 'Nouvelle-Hollande' in the Hope Collection, Oxford (specimen ODON0025-01) is available on the web (http://www.oum.ox.ac.uk/cgi-bin/odonata.cgi?detail_oid=ODON0025-01). The pertinent portion of the description relates to the abdominal colour patterning: '(French) où il est un peu comprimé, déprimé, jaune, ayant sur le dos une bande très-large d'un vert métallique devenant grisâtre sur les deux premiers segments, composée d'une série de taches qui, étroites antérieurement, se dilatent pour se rétrécir de nouveau, se dilatent postérieurement jusque stir le bord latéral et s'étendent au pen en dessous to long du bord postérieur des segments, en envahissant presque complètement les deux derniers, à l'exception du dernier, qui a l'extrémité jaune en dessus'. This can be translated as: 'where it is a bit constricted, flattened, yellow on the back with a very wide band of metallic green becoming greyish green in the first two segments, composed of a series of spots, narrow anteriorly then expanding, to shrink and then expand posteriorly onto the lateral margin, extending a little below along the edge of the posterior segments, almost completely covering the last two, except the tip of the last (which) is yellow above'.

Selys' (1871) description of *H. australiae* (Rambur) as type for the genus *Hemicordulia* is clearly of Rambur's species. In contrast, Martin's (1907) account from material in Selys' collections has the dorsum of segments 9 and 10 black in the male and in the female the dorsum of segment 10 is yellow. Reliance on Martin might underlie Tillyard's error.

I observed adult *H. australiae* in Canberra, ACT in 2003 and again in 2006. Like Watson, I felt something was different in both appearance and behaviour from New Zealand material with which I was familiar. When adults raised from larvae taken from cattle troughs being used to rear tadpoles at James Cook University campus in Townsville, North Queensland were examined, patterns became clear. These larvae had a mid-dorsal abdominal crest of spines and produced adults with a yellow tip to the abdomen, whereas larvae from New Zealand lacked the dorsal abdominal spines and produced adults with a black tip to the abdomen.

***Hemicordulia armstrongi* sp. n.**

(Figs 1-4)

Type specimens. Holotype ♂, NEW ZEALAND: labelled 'Huka Lodge, Waikato River, Taupo TO, 6 Mar 57, J.S. Armstrong, *H. australiae* (sic) ♂ in cop B' in J.S. Armstrong's hand. Paratype (allotype) ♀, NEW ZEALAND: labelled 'Huka Lodge, Waikato, River Taupo TO, 6 Mar 57 J.S. Armstrong, ♀ *H. australiae*' in J.S. Armstrong's hand. This is the only such female and is presumably 'B'.

The type specimens are from Armstrong's material in the New Zealand Arthropod Collection, currently housed in the Facilities of Landcare Research (a Crown Research Institute) on the Tamaki Campus of the University of Auckland, Auckland. They have been relabelled after the introduction of the NZ locality designator system (Crosby *et al.* 1976). The allotype is missing the right cercus.

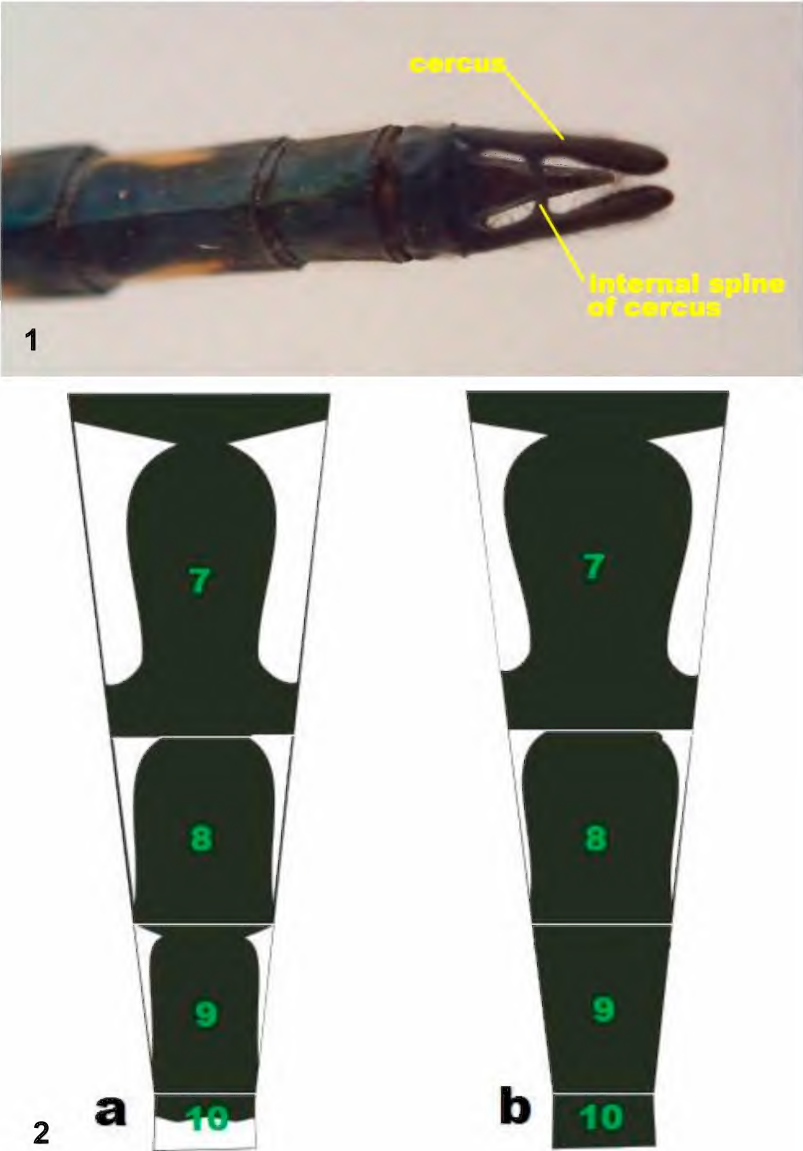
Diagnosis and description. The adult of *H. armstrongi* is extremely similar to that of *H. australiae* in most characters, including the metallic blue colouring of the upper frons in dried specimens (vivid green in live insects) and the general shape of the male superior appendages, including the strong internal spine on the cercus – characters used to distinguish *H. australiae* from other species of *Hemicordulia* in the keys of Watson, Theischinger and Abbey (1991). *Hemicordulia armstrongi* differs from *H. australiae* in five significant features: (1) in abdominal colour pattern, especially of the terminal abdominal segments; (2) in shape of the abdomen; (3) in absence of saffronation in the female wings; (4) in male reproductive behaviour; (5) in absence of a crest of dorsal abdominal spines in larvae.

In adult *H. australiae* the anterior extensions of the yellow abdominal markings on segments five, six and seven almost meet dorsally, whereas they are generally separated by dark coloration in *H. armstrongi*; in *H. australiae* there are yellow (or yellow-orange) markings on the anterolateral area of the tergite of abdominal segment nine and the distal half of the dorsum of segment ten is bright yellow, whereas in *H. armstrongi* the dorsum of segments nine and ten are uniformly black (Figs 1-3).

In *H. australiae* the distal portions of the female wings are saffronated; in *H. armstrongi* the wings are hyaline.

In *H. australiae* the male abdomen is flattened but the sides are nearly parallel; in *H. armstrongi* the male abdomen has a narrow neck about segment two then is distinctly broadened to about segment six, before narrowing to segment eight (this feature often collapses in dried specimens).

The later instar larvae of *H. australiae* possess a mid-dorsal crest of prominent blunt spines, whereas these features are absent in *H. armstrongi*. This difference is figured, with comment, in Winstanley and Brock (1983) (Fig. 4).



Figs 1-2. *Hemicordulia* spp: (1) dorsal view of the last abdominal segments of the holotype male of *Hemicordulia armstrongi* sp. n.; (2) schematic dorsal view of abdominal segments 7-10 of: (a) *H. australiae* (Rambur) and (b) *H. armstrongi* sp. n.



Fig. 3. Male *Hemicordulia* spp in flight: (a) *H. australiae* (ANU Campus, Canberra ACT, 14 December 2006, Rowe); (b) possible *H. armstrongi* (Urunga Wetlands, Urunga NSW, 23 May 2018, Ros Coy).

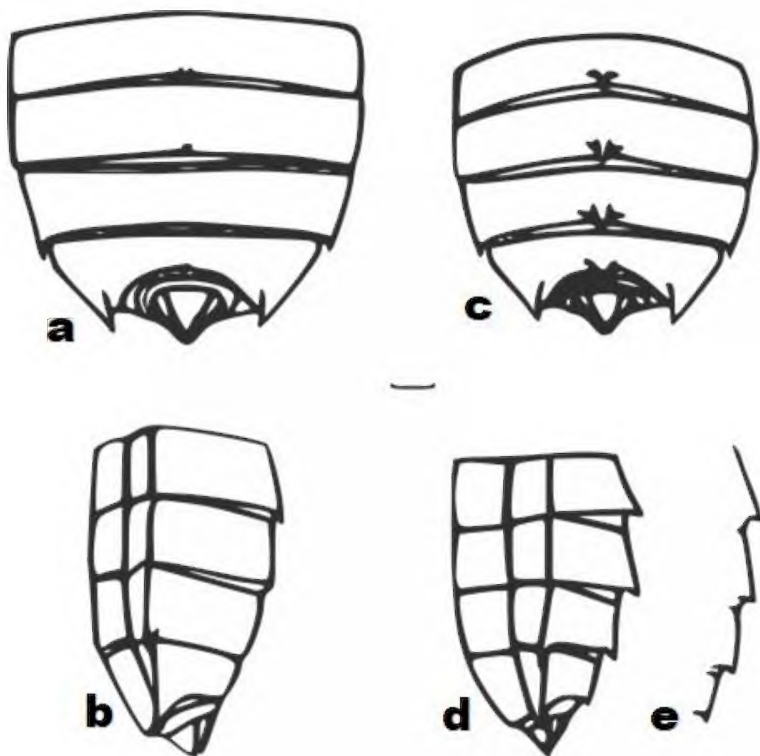


Fig. 4. Dorsal and lateral views of final instar larvae of *Hemicordulia* spp: (a-b) *H. armstrongi*; (c-e) *H. australiae*. Scale bar = 1 mm. (a-d after Winstanley and Brock 1983; e after Theischinger and Hawking 2006).

Etymology. After publishing his 1983 paper, Bill Winstanley commented to me that if the New Zealand form was specifically distinct then it should be named after the pioneering New Zealand Odonatologist John Armstrong. Armstrong's work included a paper on oviposition and egg development in this now recognised species and on its (temporary) displacement of the New Zealand endemic *Procordulia grayi* (Selys, 1876) from the Taupo region of New Zealand (Armstrong 1958, 1978). I have followed Bill's suggestion.

Discussion. *Hemicordulia armstrongi* **sp. n.** is extensively figured in Rowe (1987), under the name *H. australiae*. It is clearly an adventive species in New Zealand, with an unknown date of arrival. It was not recorded until the end of the nineteenth century despite a strong history of early collections (Rowe 1987). Museum records date from early in the twentieth century. Armstrong (1978) discussed early records and population development.

In 25 years in Townsville, North Queensland, Australia, I have seen only typical *H. australiae* and never any 'darkened northern form' (i.e. specimens like New Zealand material). In Australia, *Hemicordulia* species tend to be vagrants and I might never have collected appropriate habitats or at appropriate times. What is clear is that typical *H. australiae* occurs into the tropics and there is no particular cline. Tillyard's (1917) view that *H. australiae* is a clinal species is not supported. The existence of clear inter-linked larval and adult characters makes that position untenable.

The two species are readily distinguishable in flight from a distance of five to ten metres through the differences in abdominal colour pattern. *H. armstrongi* appears darker and the yellow terminal marking of *H. australiae* are especially distinctive.

Behaviourally, mature male *H. australiae* patrol water margins, thus closely resembling the behaviour of *Hemicordulia tau* Selys, whereas mature male *H. armstrongi* tend to hover in the centre of small open pools, cut off by vegetation from the main water body – earning them the sobriquet 'sentry' in Rowe (1987), which is followed by Marinov and Ashbee (2019).

Since no species of *Hemicordulia* resembling *H. australiae* is known from any Pacific Islands north of New Zealand (the arc from New Caledonia through to Tahiti), the origin of the new population of *H. armstrongi* that arrived in NZ in the early 20th century might have been Australia. '*Hemicordulia australiae*' is recorded from much of Australia, Indonesia (Lesser Sunda Islands), Norfolk Island, Kermadec Islands and 'New Zealand' (Watson, Theischinger and Abbey 1991, Lieftinck 1953, Winstanley 1983). However, searches of museum collections did not turn up any Australian *H. armstrongi* material. Gunther Theischinger kindly examined his own extensive collection as well as that of The Australian Museum in Sydney, without finding *H. armstrongi*. Chris Burwell inspected material in the Queensland Museum, Brisbane, again without finding *H. armstrongi*. I examined material in The Australian National Insect Collection in Canberra, again without finding *H. armstrongi*. But Martin (1907), on the basis of Australian material from Victoria, New South Wales and Queensland in Selys' collections, describes a male conforming to *H. armstrongi* as the male of *H. australiae*, *contra* Rambur (1842) and Selys (1871). Allbrook (1979) and Theischinger and Hawking (2006) illustrated *H. australiae*, whereas Taylor (2012), in a photographic guide to the West Australian fauna, illustrated a male *H. australiae* on the front cover and a male *H. armstrongi* form, with abdominal tergites 9 and 10 black, in the *H. australiae* species account about p.16. By the time of the search for Australian material Taylor had died and the actual locality for his photograph could not be confirmed. However, recent photographs which might be *H. armstrongi* from northern New South Wales and southern Queensland have been posted on the internet (e.g. Fig. 3). The status of specimens and sightings conforming to *H.*

armstrongi in Australia requires clarification and cannot yet be verified in the absence of actual modern specimens.

Winstanley (1983) recorded what might be *H. australiae* from Mayor Island, New Zealand. Since that work was published, specimens resembling *H. australiae* have been photographed in the North Island of New Zealand, so both species possibly occur there. This also requires confirmation based on collected specimens. The possibility that apparent sightings of *H. armstrongi* in Australia and of *H. australiae* in New Zealand are based on infrequent vagrants cannot be ruled out and no supporting evidence based on breeding or immature stages is available.

Modification of larval keys

In some Anisoptera the extent of larval spines can vary depending on environmental conditions (specifically being longer in the presence of fish cues) (Arnqvist and Johansson 1998). The source localities of the New Zealand *H. armstrongi* exuviae examined all had fish present. Winstanley's Norfolk Island site and Rowe's cattle troughs in Townsville lacked fish.

With the possible recognition of *H. australiae* in New Zealand, the larval keys presented in Rowe (2006) require modification. In *Hemicordulia* two species might occur: in *H. armstrongi* there is a weak mid-dorsal ridge on the abdomen, while in *H. australiae* there is a distinct ridge of blunt mid-dorsal spines on at least segments 4 to 8 (sometimes 3 to 9). If both species are present in Australia equivalent modifications will need to be made to Australian keys.

Implications

Now two sibling species are recognised, which might overlap in one or both Australia and New Zealand, it is profitable to ask questions about distribution, microhabitat selection, interactions and barriers to mating. It is likely that the dragonflies have much less difficulty distinguishing each other visually than do taxonomists. *Orthetrum sabina* (Drury, 1773) and *O. serapia* Watson, 1984 were first noticed by Watson (1984) when males of this otherwise extremely aggressive putative species were regularly ignoring close passes by some other males, seemingly of the same species. One might anticipate a similar capability in *H. armstrongi* and *H. australiae*. The yellow terminal colouring of *H. australiae* is very prominent in living insects and the wing saffronation in *H. australiae* females is likely to be a very strong signal in the UV. The rôles of these differences are now questions.

Acknowledgements

This is a tidy-up paper to record, in large part, the work of the late J.A.L. (Tony) Watson and the late W.J. (Bill) Winstanley. I also record our debt to John S. Armstrong, who worked on the biology of this species and who was a marvellous mentor.

Many thanks to Gunther Theischinger for comments and cautions on manuscript drafts and for searching museum collections, to Chris Burwell for checking Queensland Museum material, to Ros Coy and Jeff Mulvaine for producing photographs of *H. armstrongi* forms in Australia when all seemed lost.

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PHYLOGENY AND TAXONOMIC REVIEW OF *PTEROGMUS* SLOANE, *THAYERELLA* BAEHR AND *NEONOMIUS* MOORE (COLEOPTERA: CARABIDAE: MORIOMORPHINI)

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Abstract

A clade comprising *Pterogmus rufipes* Sloane, *Thayerella newtoni* Baehr and seven species of *Neonomius* Moore is recognised based on cladistic criteria. Three new species of *Neonomius* are described: *N. leai* **sp. n.** from South Australia and *N. avonensis* **sp. n.** and *N. baehri* **sp. n.** from Western Australia. All species are reviewed and a key to identification of adults is provided. Cladistic analysis indicates that *Thayerella* Baehr, precinctive to the Otway Ranges, Victoria, is adelphotaxon to *Neonomius*. Evolutionary diversification within *Neonomius* commenced in the South-West Australian area of endemism, followed by trans-Australian vicariance between species in the west versus those in New South Wales, Victoria and South Australia. That pattern, coupled with restriction of *Pterogmus rufipes* to Tasmania and *Thayerella newtoni* to the Otways, illustrates that diversification in this clade has proceeded within the most southerly temperate forest habitats of Australia. The remarkable variation in parameral setation documented among *Neonomius* spp is discussed apropos to the influence of sexual selection on diversification of this genus.

Introduction

Time is generally no friend to the taxonomist. I intended to complete this revision for the Barry Moore Memorial Issue of this journal (Monteith 2018) and, had that been done, Dr Martin Baehr would have been informed of the patronymic species honouring him that is described herein. But other studies impinged and an alternate contribution was offered (Liebherr 2018a). Such is regrettable. Conversely, during the delay in undertaking this revision, Dr David Maddison continued his molecular systematic research on Carabidae finding, with regard to this paper, that *Thayerella newtoni* Baehr (2016) is placed close to the genus *Neonomius* Moore based on molecular DNA data (D.R. Maddison pers. comm.). Taking that information as a lead, I revisited *Thayerella* Baehr specimens on loan to me from the Philip Darlington carabid beetle collection deposited at the Museum of Comparative Zoology, Harvard University. This reevaluation enabled me to corroborate Maddison's unpublished molecular data and place *Thayerella* as a member taxon of the tribe Moriomorphini; more so as the sister taxon to *Neonomius*. Baehr described his *T. newtoni* based on three female specimens, placing the genus in tribe Zolini based on the setose palpomeres. His all-female type series did not allow him access to the tribally diagnostic male characters of the protarsi and aedeagus that firmly place the genus as a moriomorphine.

The present contribution offers a revision of the seven known species of *Neonomius* Moore and places *Thayerella*, along with *Neonomius*, in a 'setose-palp clade' of Moriomorphini that also includes *Pterogmus* Sloane, monotypically represented by the Tasmanian *P. rufipes* Sloane. This three-genus clade is supported by a recently completed cladistic analysis of the

Moriomorphini, in which *Pterogmus* and *Neonomius* were placed as sister taxa (Liebherr 2020). The present inclusion of *Thayerella* in a more focused analysis allows testing of the monophyly of *Neonomius* relative to *Thayerella* and, conversely, whether *Thayerella* should remain recognised as a valid genus. Given the sister-group relationship between *Thayerella* and *Neonomius* shown below, the latter question is answered in favour of *Thayerella* monophyly and validity. Based on the restriction of these beetles to the southern temperate forests of Western Australia, Victoria, New South Wales and Tasmania, their phylogenetic relationships define historical biogeographic area relationships implicating the southern parts of Australia.

Material and methods

Material examined. This study was based on 106 specimens of *Pterogmus*, *Thayerella* and *Neonomius* deposited in the following institutional collections: Australian National Insect Collection, Canberra (ANIC); Bernice P. Bishop Museum, Honolulu, HI (BPBM); Carnegie Museum of Natural History, Pittsburgh, PA (CMNH); Cornell University Insect Collection, Ithaca, NY (CUIC); Field Museum of Natural History, Chicago, IL (FMNH); Museum of Comparative Zoology, Harvard University, Cambridge, MA (MCZ); Museums Victoria, Melbourne, Australia (MVM); South Australian Museum, Adelaide (SAMA); Western Australian Museum, Welshpool (WAM); Zoological Museum, University of Copenhagen, Denmark (ZMUC); Martin Baehr Collection deposited in the Zoologische Staatssammlung München, Germany (ZSM).

Laboratory procedures. Dissection and imaging protocols used in this study are the same as those described in recent revisions (e.g. Liebherr 2015, 2018b, c, 2020). Microscopic observations were generally conducted using a Wild M5A microscope with 10× or 20× oculars and ring-light illumination (Lucida 150 model, Hacker Instruments Inc., Fairfield NJ). *Neonomius* beetles offer special challenges for dissection, as many specimens in collections are not fully sclerotised or melanised. It might be that these beetles mature more slowly after adult eclosion than other carabid beetles, or perhaps the terrestrially focused microhabitats from which they have been recorded – e.g. in damp soil under logs or under leaf packs – represent pupation sites near which immature beetles remain until sclerotised and melanised. In any event, the high frequency of teneral specimens, combined with the generally small numbers of specimens known for each species, necessitates description of some characters from less than optimal, teneral material. Given the general rarity of *Neonomius* beetles in collections, this impediment is best surmounted by providing information that future field workers can use to build more substantial holdings of the taxa.

Characters. Several ratios of dimensions in the adult beetles can assist diagnosis; if not singly, then in combination with other ratios. Thus five different ratios are presented for diagnosis (Table 1): **1**, the ocular ratio,

Table 1. Quantitative data for species of *Pterogmus*, *Thayerella* and *Neonomius*, with number of individuals measured parenthetically following species name. Definitions of ratios presented in Characters section, Material and methods.

Species (no.)	MHW/ mFW	EyL/ OLL	no. ommatidia	MPW/ BPW	MPW/ PL	APW/ BPW
<i>P. rufipes</i> (5)	1.32- 1.38	0.52- 0.76	19	1.19- 1.27	1.29- 1.32	0.77- 0.81
<i>T. newtoni</i> (5)	1.32- 1.38	0.84- 0.89	12-13	1.24- 1.29*	1.28- 1.33	0.86- 0.92*
<i>N. leai</i> (1)	1.43	1.0	21	1.24	1.52	0.75
<i>N. australis</i> (5)	1.47- 1.56	0.91- 0.96	21-23	1.05- 1.08	1.31- 1.37	0.59- 0.64
<i>N. laevicollis</i> (5)	1.40- 1.50	0.91- 0.94	19-20	1.08- 1.13	1.40- 1.42	0.63- 0.70
<i>N. baehri</i> (1)	1.46	0.96	19	1.13	1.45	0.74
<i>N. avonensis</i> (3)	1.42- 1.47	0.93- 0.94	19	1.09- 1.10	1.32- 1.42	0.70- 0.73
<i>N. laticollis</i> (4)	1.42- 1.52	0.92- 0.95	17-19	1.08- 1.14	1.36- 1.41	0.64- 0.71
<i>N. ovalis</i> (5)	1.41- 1.50	0.96- 1.0	18	1.09- 1.18	1.41- 1.45	0.67- 0.77

* Basal pronotal width measured as transverse line between two points of minimal radial curvature along left and right laterobasal pronotal margins.

MHW/mFW, or the maximal head width across the compound eyes in dorsal view, divided by the minimal frons width between the eyes; **2**, the ocular lobe ratio, EyL/OLL, or the length of the compound eye in dorsal view, divided by the distance from the anterior margin of the eye to the juncture – i.e. or maximal change in curvature – of the ocular lobe and gena; **3**, pronotal basal constriction, MPW/BPW, or maximal pronotal width divided by the basal pronotal width; **4**, relative pronotal breadth, MPW/PL, or maximal pronotal width divided by pronotal length measured along the midline; and **5**, anterior pronotal constriction, APW/BPW, or the breadth across the pronotal front angles (measured at most-anterior point of the front margin), divided the basal pronotal width. The basal pronotal width is measured, when basal pronotal setae are present, as the distance between the two margins along a transverse line intersecting the articulation points of the two basal setae. When basal setae are not present – *T. newtoni* – basal pronotal width is defined as the length of a line drawn between the two points along the basal pronotal margins, each endpoint associated with curvature of minimal radius; i.e. maximal curvature. These dimensions were recorded using a 1.2 mm ocular micrometer divided into 0.1 mm units. Elytral shape can also diagnose species via the measure MEW/EL, or the maximal elytral width divided by

elytral length measured along the elytral suture from the base of the elevated portion of the scutellum between the elytra to the apex of the longer elytron. Standardised body length is the addition of EL, PL, plus the distance from the anteromedial labral margin to the cervical ridge at the posterior of the vertex, that last landmark estimated when necessary by the position of the head capsule relative to the prothorax.

Qualitative characters are also used extensively (Appendix 2), with terminology for the female gonocoxae and reproductive tract drawn from Liebherr and Will (1998) and terms describing the male aedeagus following Liebherr (2015).

Cladistic analysis. The present cladistic analysis rests on a comprehensive analysis of Moriomorphini (Liebherr 2020), with characters that united *Pterogmus* and *Neonomius* as sister taxa in that analysis here evaluated for *Thayerella*. Among those characters are elongate setae covering the apical maxillary and labial palpomeres, observed across Moriomorphini only in *Pterogmus*, *Neonomius* and now *Thayerella*. This was the character that Baehr (2016) used to place *Thayerella* in the tribe Zolini; however, access to male specimens requires rejection of that conclusion. Also, the pronotal hind angles are obtuse in *Pterogmus* and then synapomorphically rounded and obsolete in *Neonomius*, with that derivation shared by *Thayerella*. The elytra of *Pterogmus* bear three dorsal setae in the third interval, that number is reduced to two in *Thayerella* and *Neonomius*. Presence of either two or three setae is derived within those genera closely related to *Pterogmus* and *Neonomius* in Liebherr (2020), supporting use of this character to place *Thayerella* along with them in this clade. Also, the elytra are subquadrate with subparallel sides in all three genera evaluated here, whereas the elytra of other related genera (Liebherr 2020) are ellipsoid or ovoid. Finally, the bursa copulatrix is elongate in species of all three genera treated here (Figs 19-22), especially so for *Thayerella* and *Neonomius* (Figs 20-22). Thus this reduced analysis was restricted to those moriomorphine taxa that exhibit elongate setation on the palps – *Pterogmus*, *Thayerella* and *Neonomius*. *Pterogmus* was used to root the cladogram and, as such, the cladistic polarity of changes between *Pterogmus* and the other taxa cannot be unambiguously determined unless those changes are related to the larger cladistic structure of Moriomorphini. Those determinations are done in the presentation of results.

Phylogenetic relationships among *Pterogmus rufipes*, *Thayerella newtoni* and seven species of *Neonomius* were estimated using cladistic parsimony implemented using the Winclada data platform (Nixon 2002), with tree searching undertaken using the parsimony ratchet (Nixon 1999) while running NONA (Goloboff 1999). Of the 48 morphological characters, 36 were binary, 11 were multistate-ordered and 1 was multi-state unordered (Character 39, Appendix 2). Taxa were scored as representing multiple states if infraspecific variation was observed (Appendix 1). All characters were

scored from external anatomy, male genitalia and female reproductive tracts or gonocoxae (Appendix 2). The unique holotypes of *N. baehri* **sp. n.** and *N. leai* **sp. n.** were not dissected and their phylogenetic placement is based exclusively on external characters.

Classification

Thayerella can be placed in Moriomorphini based on: **1**, mandibular scrobe bearing a seta; **2**, frontal grooves present mesad eyes and traversing the frons anteromedially to the frontoclypeal suture; **3**, clypeus narrower than distance between antennal insertions; **4**, apical palpomeres fusiform and as long and broad as penultimate palpomere; **5**, procoxal cavities closed posteriorly; **6**, mesocoxal cavities conjunct; **7**, prothoracic leg bearing an antennal cleaner with a distal zone of short, separated setae and a basal arc of confluent setae that performs the cleaning function (Grade C of Hlavac 1971); **8**, male protarsomeres 1-4 symmetrically expanded, the basal three bearing two parallel, longitudinal rows of squamose setae.

The clade comprising *Pterogmus*, *Thayerella* and *Neonomius* is diagnosable within Moriomorphini by: **1**, apical labial and maxillary palpomeres setose, the setae arrayed as a sparse pelage over the palpomere surfaces; **2**, ligula bisetose, the setae separated by 2-4 setal diameters and paraglossae extended as far or farther beyond ligular margin as the distance from their base anterad to the ligular margin; **3**, third elytral interval with 2-3 dorsal setae; **4**, elytral humeri broad to moderately narrowed, the elytral lateral margins moderately convex to subparallel (Figs 1-9); **5**, both males and females with two apical setae each side of visible ventrite 6; **6**, body size smaller, standardised body length 3.4-6.8 mm; and **7**, female reproductive tract with bursa copulatrix elongate, length of bursa at least twice breadth (Figs 19-22). This diagnosis is taken from Liebherr (2020), augmented by knowledge of the males of *Thayerella newtoni*, that taxon now recognised as a member of this clade. Palpal setosity differs from that observed in taxa of Zolini in that both the penultimate and apical palpomeres bear a setose pelage, whereas in zoline taxa only the penultimate palpomere is setose and the apical palpomere is glabrous (Roig-Juñent and Cicchino 2001).

Key to species of the Australian genera *Pterogmus* Sloane, *Thayerella* Baehr and *Neonomius* Moore; keying to couplet 17 of Liebherr (2020)

1. Antennomere 2 (pedicel) with single seta on outer apical surface, antennomere 3 with apical ring of setae only; prosternal process margined ventrally, ventroposterior margin beaded 2
- 1'. Antennomere 2 (pedicel) and antennomere 3 both setose in apical half of length; prosternal process smooth ventrally, rounded behind
..... *Pterogmus rufipes* Sloane
2. Pronotum with both lateral and basal setae present; eyes moderately large to large, ocular ratio = 1.40-1.56, horizontal diameter of eye crosses 17-23

- ommatidia; lateral margins of pronotum and elytra concolorous with disc *Neonomius* Moore ... 3
- 2'. Pronotum with lateral seta present, basal seta absent; eyes small, little convex, ocular ratio = 1.32-1.38, horizontal diameter of eye crosses 12-13 ommatidia; lateral margins of pronotum and elytra flavous, distinctly contrasted to the piceous discs *Thayerella newtoni* Baehr
3. Pronotum moderately transverse, MPW/PL = 1.31-1.45; juncture of elytral basal groove and elytral lateral margin obtusely rounded to angulate; humerus never evenly rounded 4
- 3'. Pronotum quite transverse, MPW/PL = 1.52; juncture of elytral basal groove and elytral lateral margin broadly curved; humerus evenly rounded *Neonomius leai* **sp. n.**
4. Pronotal base smooth medially, with at most 6 or so obscure, dimpled depressions laterally, never 2-3 parallel, transverse series of punctures .. 5
- 4'. Pronotal median base punctate across breadth, punctures arrayed in confused lateral series that can extend to surround basal pronotal seta ... 6
5. Pronotal median base completely smooth; pronotal margin laterad basal seta upraised in a distinct bead; pronotum more quadrate, MPW/PL = 1.31-1.37 *Neonomius australis* (Sloane)
- 5'. Pronotum median base smooth to slightly dimpled, the depressions in a confused arrangement; pronotal margin laterad basal seta more broadly upraised, explanate, the extended cuticle translucent; pronotum more transverse, MPW/PL = 1.40-1.42 *Neonomius laevicollis* (Sloane)
6. Elytra broadly ellipsoid to hemiovoid, MEW/EL = 0.70-0.75; elytral humeri distinctly angled 7
- 6'. Elytra parallel-sided, more narrowly ellipsoid, MEW/EL = 0.66-0.68; elytral humeri obtuse-rounded to subangulate 8
7. Pronotal median base densely punctate, three parallel series of transversely arranged punctures tapering to a single series extended to basal pronotal seta; pronotal lateral marginal depression broad, explanate basally, margin broad near lateral seta, translucent and broader in basal 1/4 of length *Neonomius baehri* **sp. n.**
- 7'. Pronotal median base moderately punctate, with two parallel series of small, transversely arranged punctures medially, a single series of indistinct punctures extended to basal pronotal seta; pronotal lateral marginal depression moderately broad near basal seta but narrow in vicinity of lateral pronotal seta *Neonomius avonensis* **sp. n.**
8. Pronotal median base densely punctate, three to four confused series of transversely arranged punctures medially, two series laterally near basal

- pronotal seta; pronotum more quadrate, MEW/EL = 1.36-1.41
 *Neonomius laticollis* (Sloane)
- 8'. Pronotal median base less densely punctate, only two series of
 transversely arranged punctures medially plus a single series in explanate
 lateral margin near basal seta; pronotum more transverse, MEW/EL =
 1.41-1.45 *Neonomius ovalis* (Sloane)

***Pterogmus* Sloane, 1920**

Pterogmus Sloane, 1920: 155 (type species *Pterogmus rufipes* Sloane, by monotypy).

Diagnosis. Antennomeres 2 and 3 are both setose in their apical halves, although the setae of the pedicel are shorter and more difficult to discern. The frontal grooves are deep, extended from the mesal margin of the eye and broadest at the juncture with the frontoclypeal suture. The eyes are small and protruding, the ocular surface covering slightly more than half to 3/4 of the ocular lobe in dorsal view (Fig. 1). There is only one seta at the base of the maxillary stipes versus two in *Thayerella* and *Neonomius* spp. The pronotum exhibits distinct hind angles and the smooth median base is bordered basally by a complete marginal bead (Fig. 1). There are three dorsal elytral setae in the third interval versus two in species of the other two genera. The elytral striae are smooth, with at most indistinct crenulations along the striae lengths, not distinct punctures at the deepest portions of the striae. There is an elevated humeral tooth laterally on the basal elytral margin. The mesepisternum is broadly punctate, with about 16 punctures arrayed in four or more vertical rows across the surface, versus at most 12 punctures in at most three vertical rows in the other two genera. And the beetles are larger; standardised body length 5.2-6.8 mm.

***Pterogmus rufipes* Sloane**

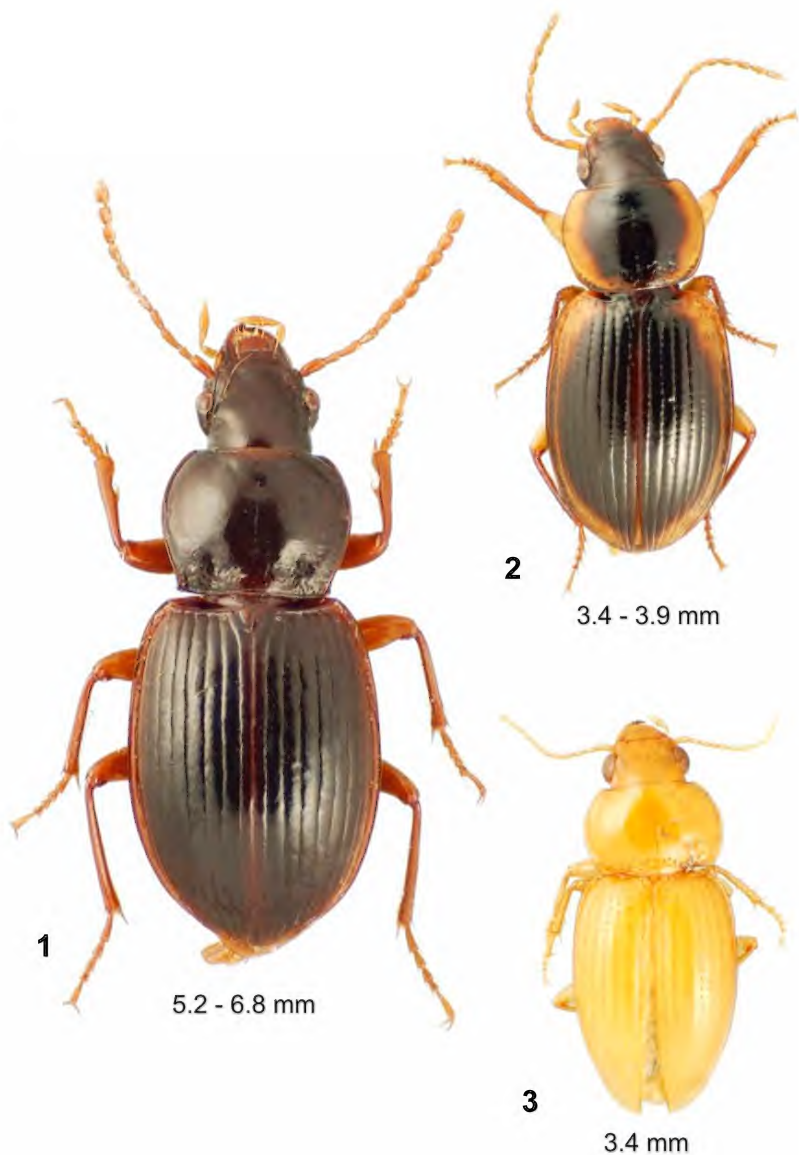
(Figs 1, 10, 15, 19, 23, 27)

Pterogmus rufipes Sloane, 1920: 156.

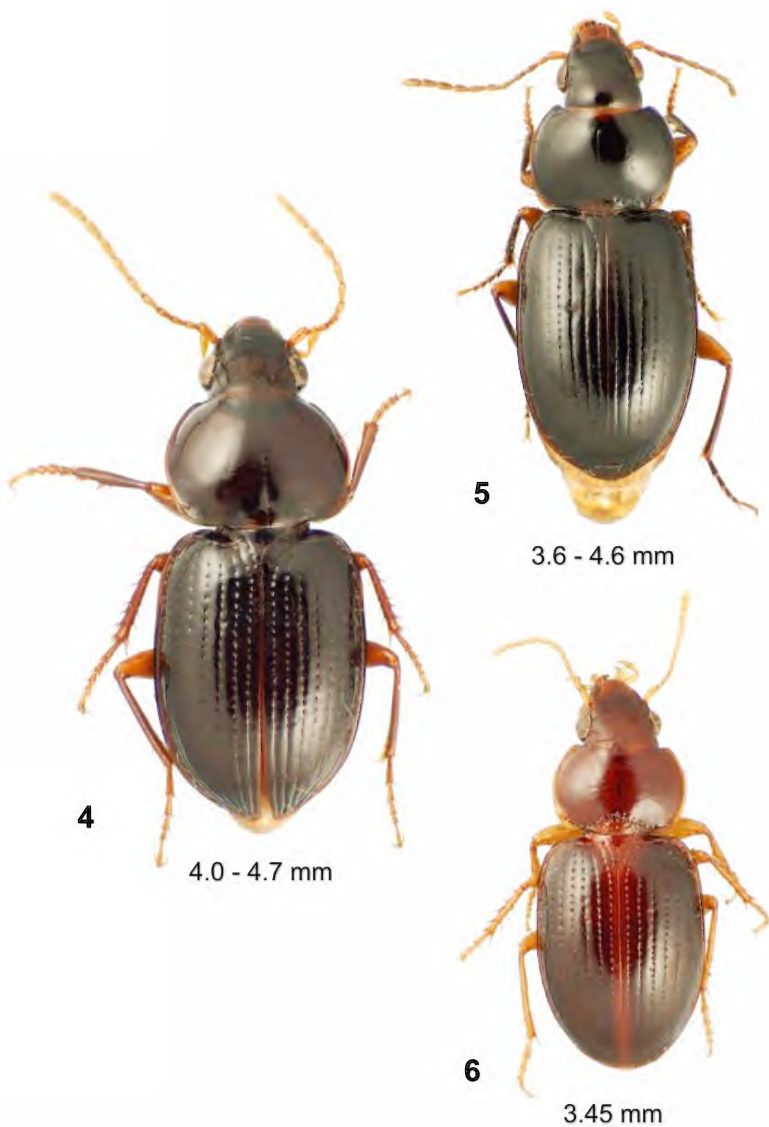
Type material. Sloane described the species from syntypes: Ben Lomond, 4000 feet (Simson No. 3124); Waratah (Carter and Lea). Moore *et al.* (1987) reported syntype deposition in SAMA for the Simson material and ANIC for a fragment of a Carter and Lea specimen in the Sloane collection.

Additional material. TASMANIA: SW, Lower Gordon R., ii-1976 (ANIC, 1), iii-1977 (ANIC, 1); Roger R. For. Res., 60 km S Smithton, 28-ii-1977 (FMNH, 1); Southwest N. P., Gordon R., 10.1 km SE Strathgordon, 325 m el., 24-i-1993 (FMNH, 1); Weldborough Pass, 26-iii-1969 (CMNH, 2).

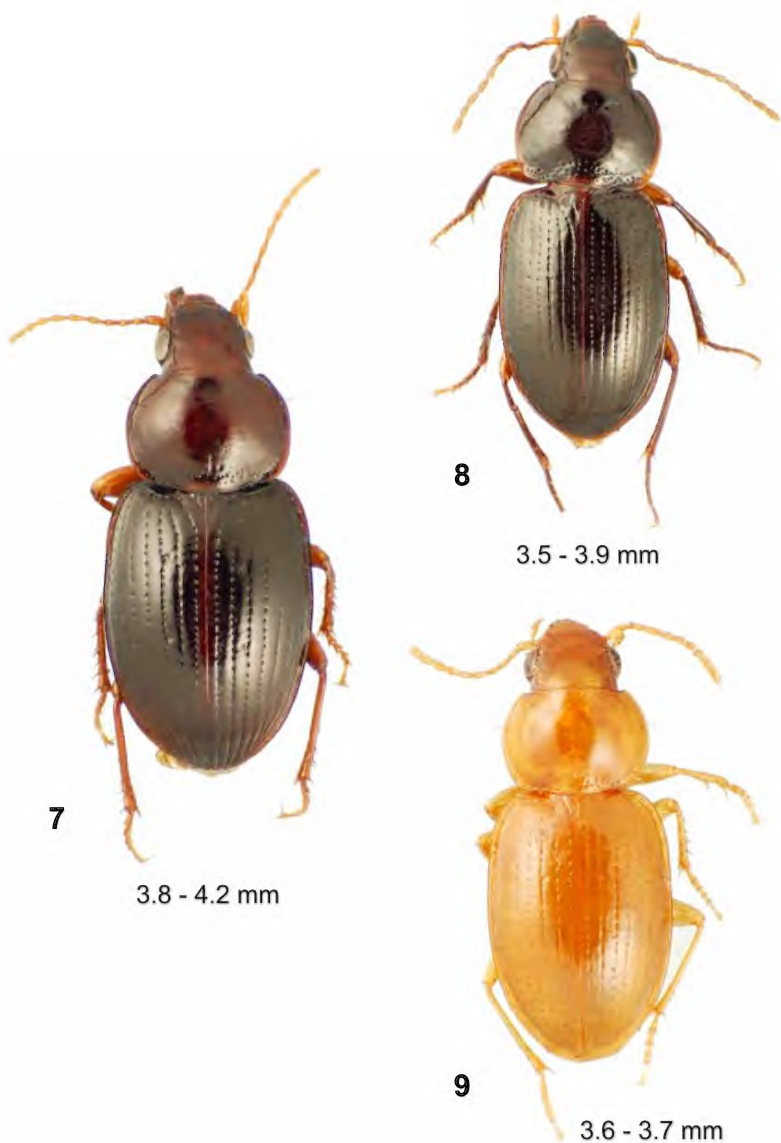
Diagnosis. In addition to generic diagnosis: male aedeagal median lobe with broad, blunt apex (Fig. 10); male right paramere narrow, elongate, with fewer than 10 very short setae apically along the ventral margin (Fig. 15), male left paramere broader, its apex rounded; female reproductive tract with bursa broad, helminthoid sclerite present near spermathecal duct-common oviduct juncture (Fig. 19) and spermathecal gland composed of two reservoirs, a



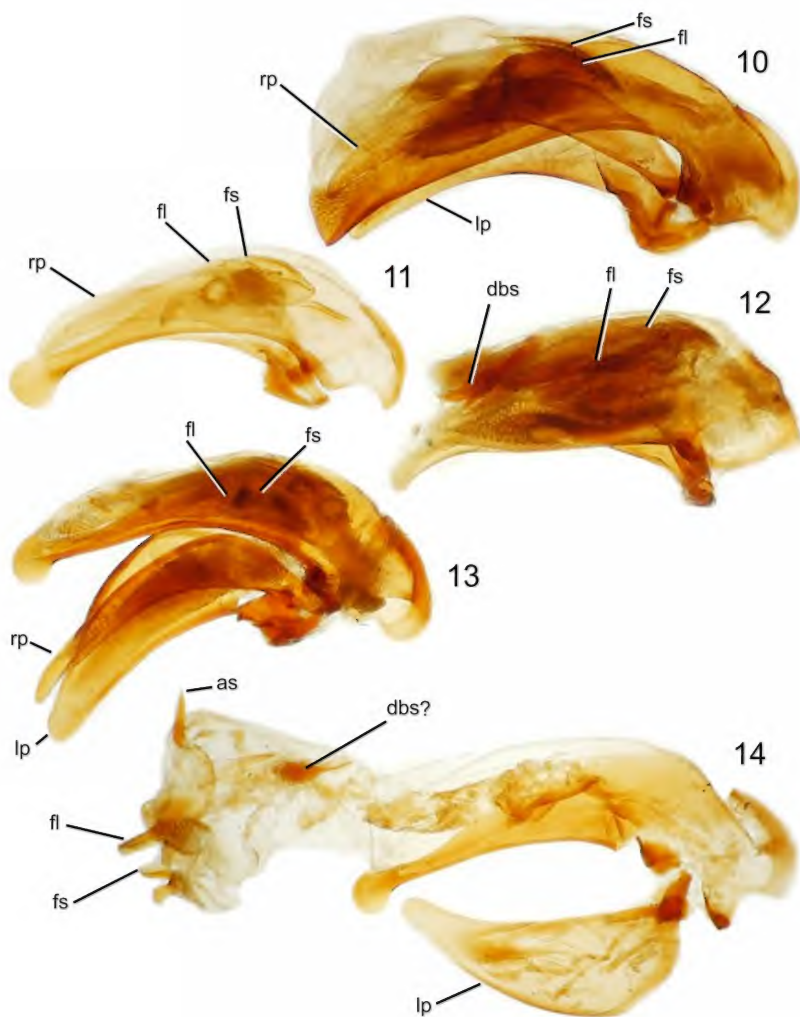
Figs 1-3. Dorsal views: (1) *Pterogmus rufipes*; (2) *Thayerella newtoni*; (3) *Neonomius leai* sp. n.



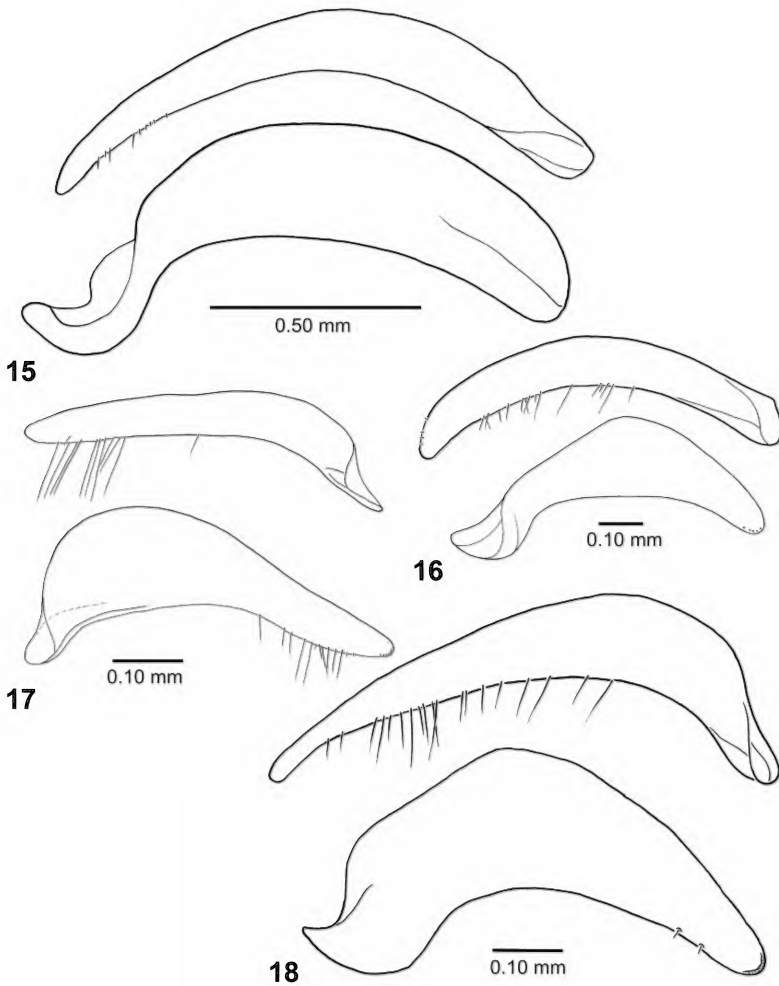
Figs 4-6. Dorsal views of *Neonomius* spp.: (4) *N. australis*; (5) *N. laevicollis*; (6) *N. baehri* sp. n.



Figs 7-9. Dorsal views of *Neonomius* spp: (7) *N. avonensis* sp. n.; (8) *N. laticollis*; (9) *N. ovalis*.



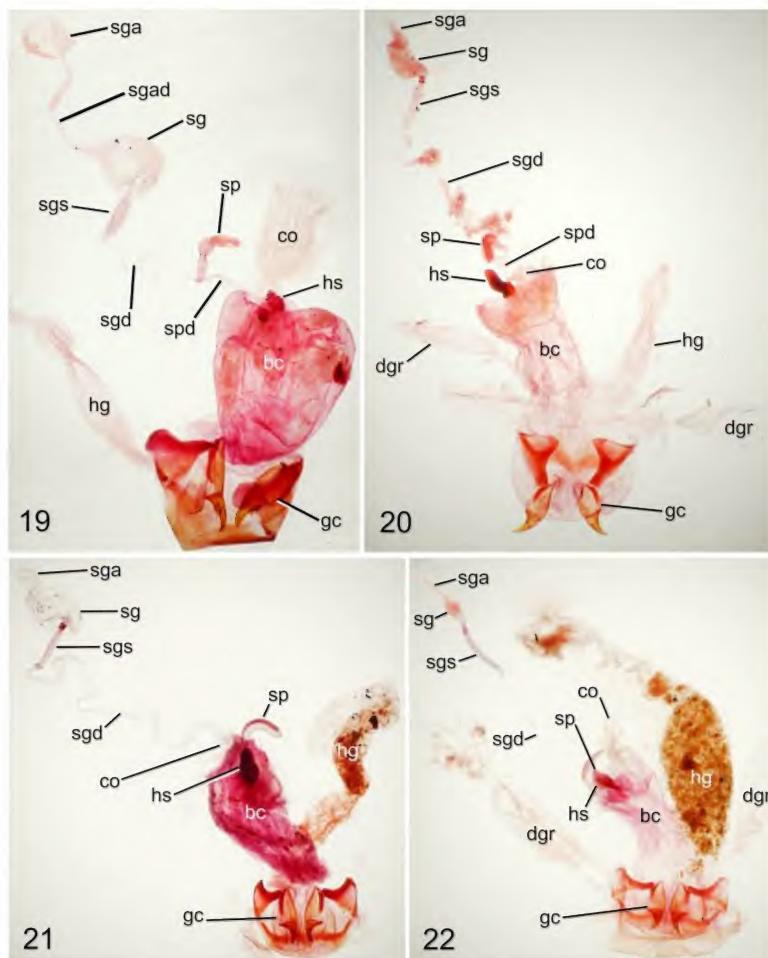
Figs 10-14. Male aedeagus, dextral view, anatomical dorsal surface upward: (10) *Pterogmus rufipes*; (11) *Thayerella newtoni*; (12) *Neonomius australis*; (13) *N. laevis*; (14) *N. laevis*, internal sac everted, right paramere removed, and left paramere inverted. Figure label abbreviations: as, apical spicule of internal sac; dbs, dorsobasal sclerite of internal sac; fl, flagellum; fs, flagellar sheath; lp, left paramere; rp, right paramere.



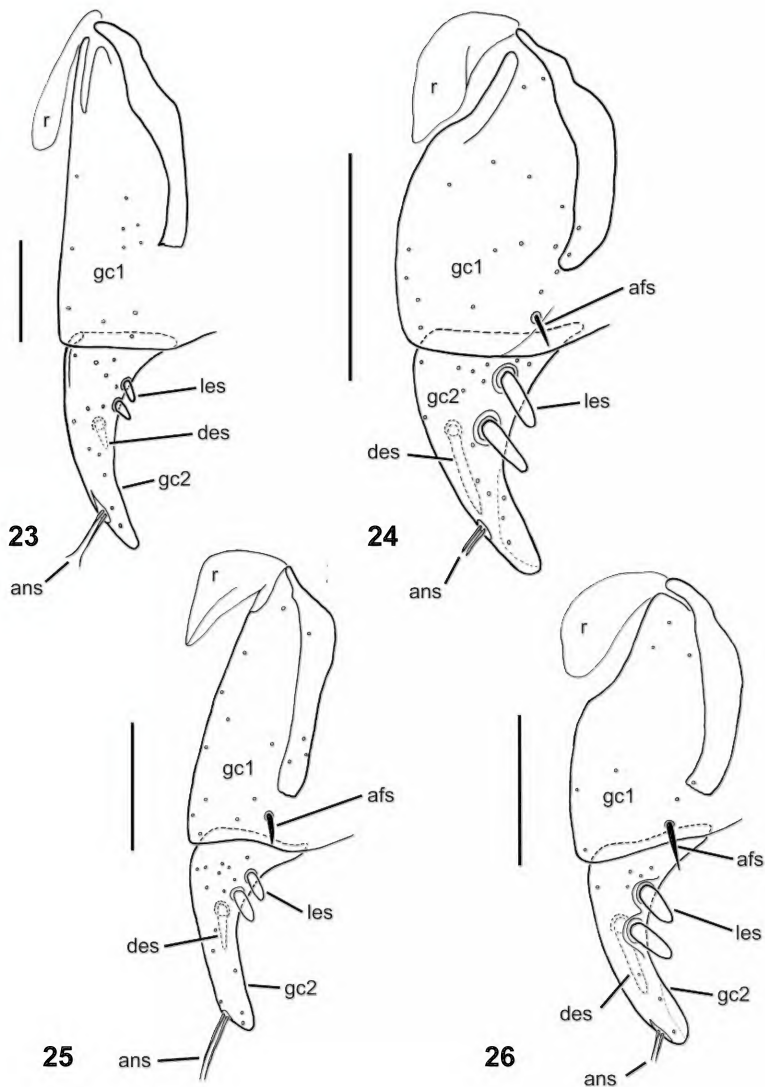
Figs 15-18. Male parameres, ectal view, anatomically dorsal margin upward; right paramere above left paramere in each paired drawing: (15) *Pterogmus rufipes*; (16) *Thayerella newtoni*; (17) *Neonomius australis*; (18) *N. laevicollis*.

basal reservoir attached to a sclerotised stem and apical appendix connected to the primary reservoir by an elongate duct. Female gonocoxa narrow, elongate, the basal gonocoxite 1 glabrous and the apical gonocoxite 2 with two very short lateral ensiform setae near base, a short dorsal ensiform seta and two moderately elongate apical nematiform setae (Fig. 23).

Variation. Moore (1963, fig. 9) illustrated two short setae near the apicoventral margin of the left paramere indicating that there is variation in this attribute of the left paramere (Fig. 15).



Figs 19-22. Female reproductive tract, ventral view: (19) *Pterogmus rufipes*; (20) *Thayerella newtoni*; (21) *Neonomius laevicollis*; (22) *N. avonensis* **sp. n.** Label abbreviations: bc, bursa copulatrix; co, common oviduct; dgr, defensive gland reservoir; gc, gonocoxa; hg, hindgut; hs, helminthoid sclerite; sd, spermathecal duct; sg, spermathecal gland; sga, spermathecal gland appendix; sgad, spermathecal gland appendix duct; sgd, spermathecal gland duct; sgs, spermathecal gland stem; sp, spermatheca; spd, spermathecal duct.



Figs 23-26. Female left gonocoxa, ventral view: (23) *Pterogmus rufipes*; (24) *Thayerella newtoni*; (25) *Neonomius australis*; (26) *N. laevicollis*. Label abbreviations: afs, apical fringe setae of gonocoxite 1; ans, apical nematiform seta of gonocoxite 2; des, dorsal ensiform seta of gonocoxite 2; gc1, basal gonocoxite 1; gc2, apical gonocoxite 2; les, lateral ensiform setae of gonocoxite 2; r, ramus. Scale bars = 0.10 mm.

Distribution and habitat. This species is restricted to Tasmania, although even the limited number of specimens examined for this review indicates habitats ranging greatly in elevational and geographic extent (Fig. 27).

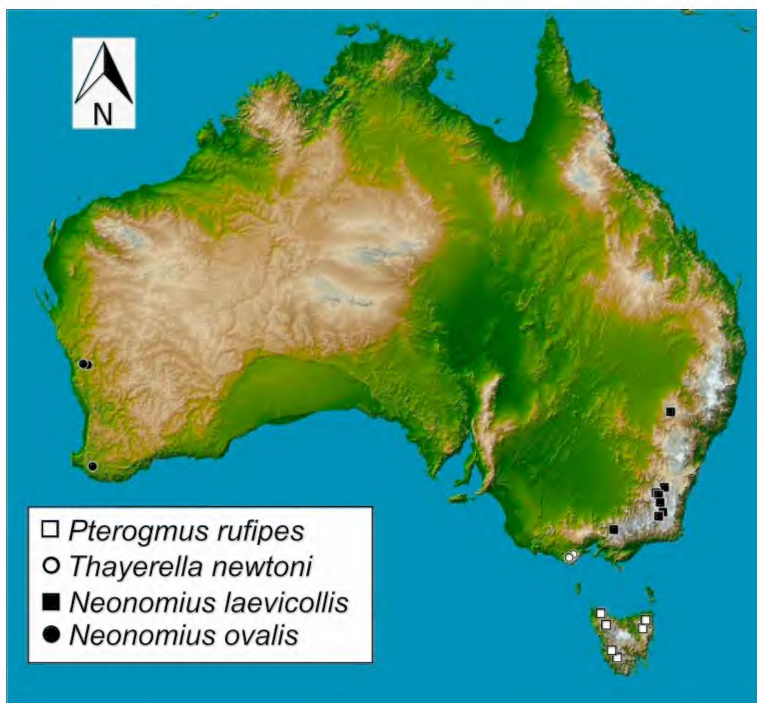


Fig. 27. Geographic localities represented by specimens of *Pterogmus rufipes*, *Thayerella newtoni* and *Neonomius* spp.

***Thayerella* Baehr, 2016**

Thayerella Baehr, 2016: 39 (type species *Thayerella newtoni* Baehr, by original designation).

Diagnosis. Immediately diagnosable by the bicolored body, with head and pronotal and elytral discs piceous, in contrast with the flavous pronotal and elytral margins, antennae and legs (Fig. 2). The pronotum is broad apically, with APW/BPW = 0.86-0.92. The eyes are only moderately convex – ocular ratio 1.32-1.38 (n = 5) – similar to the ocular ratio for *Pterogmus rufipes* but less than those observed among *Neonomius* spp: 1.40-1.56. However the eyes are relatively much larger than in *Pterogmus rufipes* (Fig. 1), covering much of the ocular lobe (Fig. 2), as observed in *Neonomius* spp (Figs 3-9). As in *Pterogmus rufipes*, the basal pronotal angles are glabrous, although conversely, as in *Neonomius* spp, they are rounded. There are only two dorsal

elytral setae in the third interval, a character shared with *Neonomius* but differing from *Pterogmus*, which exhibits three such setae. Also, the elytral striae are punctate (Fig. 2), with all striae developed laterally and apically, whereas *Pterogmus rufipes* exhibits a full complement of smooth striae. *Neonomius* spp exhibit punctate striae, although they are less well developed laterally, with either striae 5-7 or 6-7 reduced to obsolete. Standardised body length 3.4-3.8 mm, broadly overlapping lengths exhibited by specimens representing *Neonomius*.

***Thayerella newtoni* Baehr**

(Figs 2, 11, 16, 20, 24, 27)

Thayerella newtoni Baehr, 2016: 39.

Type material. Holotype ♀, VICTORIA: 38.39S 143.42E, Haines Junct. 525 m. 1.9 km W on Turton's Track 809, 25i-8ii-1987, A. Newton & M. Thayer // wet scler. forest FMHD 87-215 Berl. leaf and log litter. In ANIC. *Paratypes:* 2 ♀♀ with identical data (ANIC, 1; ZSM, 1).

Additional material. VICTORIA: Otway Ranges, iv-1957, Darlingtons (MCZ, 19), ix-1957, Darlingtons (MCZ, 1); Great Otway N.P., Triplet Falls Tk., raking litter, *Eucalyptus* forest, 38, 40.235'S 143 29.69'E, 300 m el., 14-ii-2011, Liebherr (CUIC, 1).

Diagnosis. Consistent with membership in Moriomorphini, with male protarsomeres 1-4 symmetrically dilated apically and tarsomeres 1-3 ventrally bearing two longitudinal series of squamose setae. Genital characters confirm this assignment. Male aedeagal median lobe with closed basal bulb, a short flagellum and associated flagellar sheath present on the internal sac (Fig. 11); median lobe apex expanded dorsoventrally, rounded; right paramere elongate, apex slightly narrowed, rounded, the paramere's ventral margin bearing approximately 16 short to moderately elongate setae (Fig. 16); left paramere dorsally expanded, broadest near midlength, rounded apically with the apical margin lined with round sensillar pores. Female reproductive tract with bursa copulatrix elongate, length about three times breadth (Fig. 20); elongate helminthoid sclerite present near juncture with spermathecal duct and common oviduct; spermathecal duct about as long as spermathecal reservoir; spermathecal gland duct elongate, the spermatheca composed of a discrete sclerotised stem and a flocculent, membranous gland with an apically narrowed appendicular portion; gonocoxa divided, with basal gonocoxite bearing a single seta laterally near apical margin; apical gonocoxite subtriangular with narrowly rounded apex (Fig. 24), bearing two elongate lateral ensiform setae, one elongate dorsal ensiform seta and two short apical nematiform setae.

Distribution and habitat. Restricted to the Otway Ranges of Victoria (Fig. 27). Specimens have been collected in Berlese samples of leaf and log litter from – and during litter raking in – wet sclerophyll (*Eucalyptus*) forest.

Neonomius Moore, 1963

Neonomius Moore, 1963: 287 (type species *Mecyclothorax laevicollis* Sloane, by original designation).

Diagnosis. Species of *Neonomius* (Figs 3-9) can be diagnosed from the other two moriomorphine genera with setose apical palpomeres – i.e. *Pterogmus* and *Thayerella* – by: **1**, eyes convex and covering much of ocular lobe, ocular ratio 1.40-1.56 and ocular lobe ratio 0.91-1.0; **2**, pronotal basal seta present with pronotal margin near seta expanded laterally; **3**, parascutellar striae punctate; **4**, discal elytral striae distinctly punctate, the punctures expanding striae breadth, or isolated from each other by striae discontinuities; **5**, elytral striae 5-7 or 6-7 reduced, shallow to obsolete; and **6**, spermatheca sessile at juncture with common oviduct (Figs 21-22), not borne on a narrow spermathecal duct (e.g. Figs 19-20).

***Neonomius leai* sp. n.**

(Figs 3, 37)

Type material. *Holotype* ♀, point mounted, SOUTH AUSTRALIA: Pt. Lincoln / S. A.; Lea // S. Aust. Museum / Specimen [orange label] // *Neonomius* sp. / near *laevicollis* / Sl. / det. B. P. Moore '82 // HOLOTYPE / *Neonomius* / *leai* / J.K. Liebherr 2019 [black-margined red label]. In SAMA.

Diagnosis. This small-bodied species – standardised body length 3.4 mm – shares with *N. ovalis* a reduced elytral subapical sinuation, a smooth mesepisternum with four punctures arrayed in a single vertical row and a broadly triangular metasternal process between the mesocoxae. The species (Fig. 3) can be diagnosed from all other *Neonomius* by the transverse pronotum, MPW/PL = 1.52 (Table 1) and the substantial constriction of the pronotal base; MPW/BPW = 1.24. The eyes are well developed, with the compound eye covering all of the ocular lobe and a horizontal line crossing the eye intersecting 21 ommatidia.

Description. Head broad, vertex convex between eyes, frontal grooves very shallow, broad; two supraorbital setae present each side; antennae short and robust, antennomere 9 length 1.5× greatest breadth; labrum with slight medial concavity, the anterior margin rounded laterally; mandibles elongate, mandibular length from anterior condyle 2× distance from condyle to labral anterolateral margin; mentum tooth rounded, sides defining acute angle; submentum with inner plus outer pairs of setae; mentum breadth 2.75× length of lateral lobes; ligular apex truncate, moderately broad, the two ligular setae separated by 4 setal diameters; paraglossae extended slightly farther beyond ligular margin than distance from base to ligular margin, separated from ligula. Pronotum quadrisetose, lateral setae positioned 0.62× length before hind angles; basal margin distinctly trisinate, margin angularly concave laterad median base, that concavity distinctly margined; median longitudinal impression very shallow, evidenced by darker coloration of internal

apodeme; anterior surface of pronotum convex, anterior margin smooth medially, a marginal bead present in outer half of breadth; front angle slightly protruded, margin rounded posterad and marginal depression slightly broader than marginal depression at midlength; prosternum smooth, convex medially; prosternal process margined on sides with marginal bead continued medially on posterior surface of process; proepisternum smooth, suture with proepimeron slightly irregularly impressed. Elytra convex, sides meeting lateral marginal depression vertically; parascutellar striole with 3-4 punctures, striole continuous between punctures, parascutellar seta present just laterad base of sutural stria; basal groove slightly curved laterally, margin narrowly rounded at humerus; 2 dorsal elytral setae present, the anterior about 1/4 elytral length, posterior just beyond midlength; lateral elytral setae arranged as 7 anterior setae, 6 posterior setae; both subapical and apical setae present, former in stria 7, latter near elytral apex at stria 2; discal elytral striae 1-5 punctate, the punctures joined by the shallowly impressed striae, stria 6-7 represented by series of isolated lenticular punctures; stria 8 continuous along length, finely punctate to crenulate between anterior and posterior series of lateral setae; interval 8 broadly convex laterad subapical seta. Pterothorax foreshortened; mesepisternum smooth with 4 punctures in vertical line along deepest portion; metepisternum an equilateral trapezoid; metepimeron distinct; flight wings vestigial. Abdomen with ventrites smooth, suture between ventrite 1 and 2 straight, ventrite 2 depressed along strigose suture; suture between ventrites 2 and 3 well developed, slightly sinuate laterally, base of ventrite 3 distinctly strigose. Legs gracile; profemur glabrous anteriorly, with 2 setae posteroventrally; metatarsomere 1 length $0.2\times$ tibial length, a shallow groove present on outer dorsal surface; metatarsomere 4 outer lobe $1.33\times$ median length. Microsculpture reduced on head, surface glossy with indistinct transverse lines over portions of the cuticle; pronotal disc glossy but with transverse mesh, sculpticell lengths $2-3\times$ breadth present in irregular wrinkles; elytral disc glossy, with indistinct transverse lines over portions, its apex glossy with indistinct transverse mesh in irregularities.

Female reproductive tract. The single, teneral female holotype specimen was not dissected.

Distribution and habitat. The lone specimen known of this species was collected at Port Lincoln by A.M. Lea. Based on his time as curator at the South Australian Museum (Matthews 1986), the collecting date would most likely have been between 1911 and 1924.

Etymology. This species is named to honour Arthur Mills Lea, a multitalented entomologist who, among numerous achievements, successfully undertook control of codling moth, *Cydia pomonella* (L.), in Tasmania and then completed an incredibly prolific taxonomic career describing beetles while working as the curator of entomology at the South Australian Museum (Matthews 1986).

***Neonomius australis* (Sloane)**

(Figs 4, 12, 17, 25, 37)

Mecyclothorax australis Sloane, 1915: 450.*Neonomius australis*, Moore 1963: 287.

Type material. *Holotype*, WESTERN AUSTRALIA: Karri Forest / W. A. 4.1.14 T.G.S. // *Mecyclothorax / australis* Sl. / *Type*. // *M. australis* / *Holotype* / PJD [pink label]. In ANIC.

Additional material. WESTERN AUSTRALIA: Margaret R., xi-1931, Darlington (MCZ, 2); Pemberton, 16 km S, Brockman N. P., FMHD#76-487, leaf litter & mold under thorny *Acacia divergens* – 3 years, 8-xii-1976, Kethley (FMNH, 1); Walpole N. P., Coalbine, 6 km E, litter under *Casuarina*, FMHD#76-494, 13-xii-1976, Kethley (FMNH, 2); Walpole N. P., 20 km E, 102, 1-xii-1987, Baehr (ZSM, 1); Shannon N. P., Great Forest Trees Dr. nr. Curtin Tank, jarrah forest (*Euc. marginata*) w/*Banksia* etc., FMHD#2004-118, flight intercept trap, 34° 32.04' S 116° 25.08' E, 190 m el., 11-vii-2004, Newton, Solodovnikov *et al.*, 1107 (FMNH, 3).

Diagnosis. The combination of robust prothorax with the pronotal disc broadly quadrate (Fig. 4) and smooth pronotal median base with a complete basal marginal bead serves to diagnose this species. Only some individuals of *N. laevicollis* exhibit reduced punctation of the pronotal median base along with a complete basal marginal bead; however, *N. australis* exhibits a more robust pronotum – MPW/PL = 1.31-1.37 – with the pronotal apex relatively more constricted; APW/BPW = 0.59-0.64 (Table 1). In combination with the broad pronotum, the elytra are broad, the humeri well developed and the lateral elytral margins parallel. The discal elytral striae are deeply punctate, with the striae reduced in depth to discontinuous between the punctures. The ocular lobe is projected and the eyes well developed with 21-23 ommatidia crossed by a horizontal line across the eye. Standardised body length ranges 4.0-4.7 mm.

Male genitalia. Aedeagal median lobe broad basally, narrowly extended apically with a rounded tip (Fig. 12); based on unverted specimen, two-toothed dorsobasal sclerite and an elongate flagellum and associated flagellar sheath present; right paramere narrow, parallel-sided, with a rounded tip, apical third of ventral margin lined with approximately 10 elongate setae accompanied by several short setae (Fig. 17); left paramere broadest in basal third, apical third of ventral margin lined with about nine setae, several longer and the remainder short.

Female reproductive tract. Bursa copulatrix elongate, length 3-4× breadth; helminthoid sclerite present near juncture of common oviduct and spermatheca; basal gonocoxite 1 with a single short, apical fringe seta laterally (Fig. 25); apical gonocoxite 2 narrow basally, parallel-sided apically, with two short lateral ensiform setae, one short dorsal ensiform seta and two moderately elongate apical nematiform setae.

Distribution and habitat. This species is restricted to southwestern coastal Western Australia, from south of Geographe Bay at Margaret River to Walpole and Shannon National Parks along the southern coast (Fig. 37). All specimens are from terrestrial microhabitats: the holotype under a log in karri – *Eucalyptus diversicolor* F. Muell. – forest and three specimens each in litter under *Casuarina* and from a flight intercept trap in jarrah – *Eucalyptus marginata* Donn. ex Sm. – forest. The flight intercept trap included a ground-level trapping pan, within which the flightless beetles were collected (A.F. Newton pers. comm.).

***Neonomius laeivcollis* (Sloane)**

(Figs 5, 13, 14, 18, 21, 26, 27)

Mecyclothorax laeivcollis Sloane, 1915: 449.

Neonomius laeivcollis, Moore 1963: 287.

Type material. *Lectotype* ♂, AUSTRALIAN CAPITAL TERRITORY: left specimen on card, dissected // Kosciusko / 1.06. HLC // *Mecyclothorax / laeivcollis* Sl. / Type // Holotype PJD / *Mecyclothorax laeivcollis* Sl. // LECTOTYPE / *Mecyclothorax / laeivcollis* Sloane / (left dissected male) / det. J.K. Liebherr 2004 [black-margined red label]. *Paralectotype*: right specimen on card // same data as above. Both in ANIC.

Additional material. AUSTRALIAN CAPITAL TERRITORY: Brindabella Rge., Piccadilly Circus, 1200 m el., 10-xii-1987, Baehr (ZSM, 1), to Mt. Gingera, 6000 ft. el., v-1957, Darlingsons (MCZ, 14). NEW SOUTH WALES: East Boyd S. F., in grass and earth at edge of swamp, VWHL #77, 27-iv-1991, Lorimer (ZSM, 1); Fraser [*sic*? Frazer] Park, 29-xi-1946, Oke, (ZSM, 1); Kosciuszko N. P., Cumberland Rge., *Eucalyptus* forest, sifted litter, 35°38.62'S 148°23.30'E, 1200 m el., 21-xii-2008, Schomann & Pedersen (ZMUC, 1), Guthega, 3.4 km NE, *Euc. pauciflora* w/ shrubs, FMHD #86-643, Berlesate, leaf and log litter, 36°22'S 148°24'E, 1580 m el., 11-xii-1986, Newton & Thayer (FMNH, 1), Mt Kosciusko, 7000 ft. el., 7-xii-1922, Sloane (MVM, 1), 5-7000 ft. el., 11-xii-1931, Darlington (MCZ, 3), xii-1931, Darlington (MCZ, 2), Mt Kosciusko summit, iii-1958, Darlingsons (MCZ, 4), Ravine 4WD Track at Wallace's Ck., raking roadside litter, dirt, 35°52.135'S 148°35.325'E, 1330 m el., 24-ii-2011, Liebherr (CUIC, 13), Saw Pit Cr., 4000 ft. el., 11-xii-1931, Wheeler (MCZ, 1); Tumutu R. [*sic* Tumut R.], 1956, Sedlacek (BPBM, 2). VICTORIA: Pretty Vy, Mt Bogong, 5700+ ft. el., iv-1958, Darlingsons (MCZ, 1).

Diagnosis. Like *N. australis*, this species exhibits a complete pronotal basal marginal bead; however, this is accompanied by at least 6 or more shallow punctures on the median base plus other punctures extended toward the pronotal hind angles. The pronotum is transverse (Fig. 5), MPW/PL = 1.40-1.42, broader relatively (Table 1) than either of the similar-appearing *N. australis* (Fig. 4) or *N. laticollis* (Fig. 8). Compared with *N. australis*, the elytra are much narrower in *N. laeivcollis* (Figs 4-5) and compared with *N. laticollis*, the pronotal base is much less densely punctate (Figs 5, 8). The discal elytral punctures are also smaller in *N. laeivcollis*, resulting in smoother, more continuous striae 1-4. Conversely, the mesepisternum is more punctate in this species, with about 12 punctures arrayed in 2-3 vertical

rows, versus about 6-7 punctures in 1-2 vertical rows in both *N. australis* and *N. laticollis*. Standardised body length ranges 3.6-4.6 mm.

Male genitalia. Aedeagal median lobe moderately broad basally, evenly narrowed apically to spatulate, dorsoventrally expanded tip (Fig. 13); internal sac with multiple sclerotised structures, including a possibly homologous dorsobasal sclerite, a pointed apical sclerite and a parallel-sided, file-like flagellum with associated flagellar sheath, the latter near a sclerotised, knob-like projection (Fig. 14); right paramere elongate, broadest in basal third and evenly narrowed to an extended, narrowly rounded tip (Fig. 18), with the apical 2/3 lined with about 20 setae, the majority longer and a few short; left paramere broad, dorsal margin maximally expanded near midlength and apex broadly rounded, two very small setae on ventral margin near tip.

Female reproductive tract. Bursa copulatrix elongate, length about 3× length (Fig. 21); stout helminthoid sclerite present at juncture of common oviduct and spermathecal base; spermathecal gland duct elongate, spermatheca with long, sclerotised stem, the reservoir extended apically into a short appendix; basal gonocoxite 1 broad, with a single apical fringe seta laterally (Fig. 26); apical gonocoxite 2 narrow basally, with parallel-sided apex and round tip, bearing two moderately elongate lateral ensiform setae, an elongate dorsal ensiform seta and two short apical nematiform setae.

Distribution and habitat. This species is the most broadly distributed *Neonomius* based on records spanning East Boyd S.F., New South Wales, to Mt Bogong in Victoria. Nearly all specimens with ecological information have been collected in *Eucalyptus* forest at elevations from 1200-1800 m. A series of 13 specimens was collected by raking the dry soil and litter at night along the margins of a 4WD track in closed canopy *Eucalyptus* forest. The soil was dry and composed of fine particles, with the beetles burrowing into the soil layer upon illumination by headlamp. Conversely, the specimen from East Boyd S.F. was collected 'in grass and earth at edge of swamp', indicating some latitude in microhabitat preference.

***Neonomius baehri* sp. n.**

(Figs 6, 37)

Type material. Holotype ♀, point mounted, WESTERN AUSTRALIA: R.P. McMillan / Cannington / 30.7.53 // Western Australian / Museum Collection / 97/790 [yellow label] // Western Australian / Museum Entomology / Reg no. 23833 [golden label] // *Neonomius* / sp. (nov?) / det. M. Baehr '98 // HOLOTYPE / *Neonomius* / *baehri* / J.K. Liebherr 2019 [black-margined red label]. In WAM.

Diagnosis. This small-bodied species – standardised body length 3.45 mm – can be diagnosed by the transverse pronotum, MPW/PL = 1.45 (Table 1), in combination with the densely punctate pronotal median base, those punctures obscuring the pronotal basal marginal bead. The pronotal lateral marginal depression is moderately broad throughout its length, with the lateral pronotal

seta situated within the depressed margin. The elytra are broadly ellipsoid, with the lateral margins convex, and the mesepisternum is smooth with about 4 punctures arrayed in a single vertical line. Dorsal body microsculpture is reduced with the vertex and pronotal disc glossy; however, the elytra exhibit indistinct transverse lines or an elongate transverse mesh over portions of the surface.

Description. Head broad with convex eyes; ocular lobe slightly depressed at slightly obtuse genal juncture, a narrow band of cuticle bordering the eye along the posterior margin of the lobe in dorsal view; two supraorbital setae present each side; frontal groove broad at frontoclypeal suture, shallowly extended to the anterior supraorbital; antennae robust, antennomere 9 length $1.57\times$ maximal breadth; labrum anterior margin broadly concave medially, the margin narrowly rounded each side, labrum subquadrate; mandibles moderately elongate, length from anterior condyle $1.82\times$ distance from condyle to lateroapical margin of labrum; mentum tooth rounded, sides defining acute angle; submentum with inner and outer pairs of setae; mentum breadth $2.33\times$ length of lateral lobes; ligular apex broad, truncate, ligular setae separated by 4 setal diameters; paraglossae extended as far beyond ligular margin as distance from base to ligular margin, separated from ligula. Pronotum quadrisetose, lateral setae positioned $0.65\times$ length before hind angles; basal margin distinctly trisinuate, margin angularly concave laterad extended median base, margin of that concavity upraised; median longitudinal impression finely incised, continuous; anterior transverse impression evidenced medially by transverse depression, obsolete laterally; anterior margin smooth medially, a broad marginal bead present in outer $2/3$ of breadth; front angle protruded, margin tightly rounded, marginal depression slightly broader at front, but moderately broad throughout pronotal length; prosternum smooth, convex medially; prosternal process broadly margined on sides with marginal bead continued medially on posterior surface of process; proepisternum smooth, suture with proepimeron deep and smooth. Elytra broadly convex, sides sloping to meet lateral marginal depression; parascutellar striae with 3-5 punctures, striae continuous between punctures; parascutellar seta present in base of sutural stria; basal groove slightly curved laterally, margin narrowly rounded at humerus; 2 dorsal elytral setae present, the anterior about $1/3$ elytral length, posterior just beyond midlength; lateral elytral setae arranged as 7 anterior setae, 6 posterior setae; both subapical and apical setae present, former in stria 7, latter near elytral apex at stria 2; elytral striae 1-6 distinctly punctate, the punctures joined by the shallowly impressed striae, stria 7 represented by series of shallower lenticular punctures, these still shallowly connected; stria 8 continuous along length, finely, distinctly punctate between anterior and posterior series of lateral setae; interval 8 broadly convex laterad subapical seta. Pterothorax foreshortened; mesepisternum smooth with 4 punctures in vertical line along deepest portion; metepisternum an equilateral trapezoid;

metepimeron distinct; flight wings vestigial. Abdomen with apical ventrites smooth; visible ventrite 1 with median transverse series of punctures, suture between ventrite 1 and 2 straight, ventrite 2 depressed along strigose suture; suture between ventrites 2 and 3 well developed, slightly sinuate laterally. Legs gracile; profemur glabrous anteriorly, with 2 setae posteroventrally; metatarsomere 1 length $0.21 \times$ tibial length, a shallow groove present on outer dorsal surface; metatarsomere 4 outer lobe $1.2 \times$ median length. Microsculpture reduced on head, surface glossy with micropunctures visible over surface; pronotal disc glossy but with transverse mesh, sculpticell lengths $2-3 \times$ breadth present in irregular wrinkles; elytral disc glossy, with indistinct transverse lines over portions, its apex covered with shallow, irregular isodiametric mesh.

Female reproductive tract. The single female holotype was not dissected.

Distribution and habitat. The holotype was collected at Cannington, southeast of Perth (Fig. 37) without associated ecological data.

Etymology. This species is named in honour of Martin Baehr, who contributed immensely to our understanding of Australian carabid beetles through his vast body of taxonomic works. Martin recognised this species as new, but left it for another to describe.

***Neonomius avonensis* sp. n.**

(Figs 7, 22, 28, 31, 34, 37)

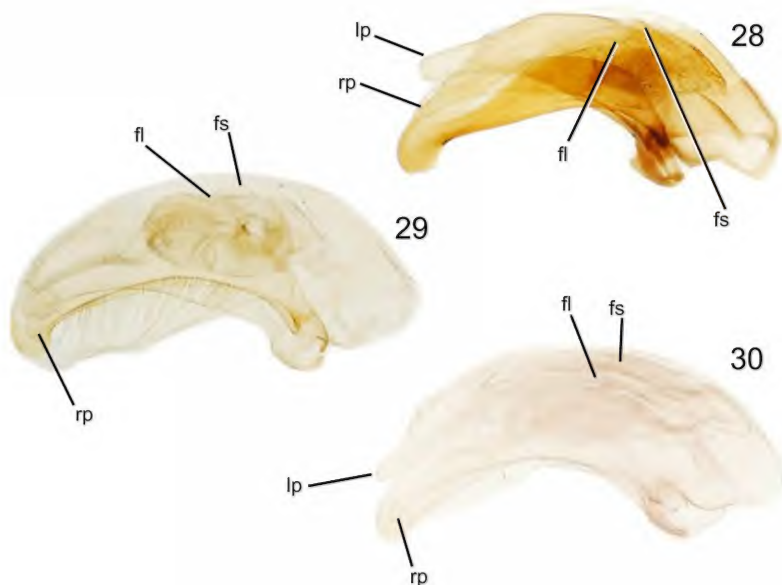
Type material. Holotype male, point mounted, WESTERN AUSTRALIA : W. Aust. : / Avon Valley N. P. Gover- / nor's Drive, 1.2 km from / Forty-One Mile Rd., 260 m, / $31^{\circ}36.57'S$, $116^{\circ}15.04'E$, // 27.vii.2004, *Euc. ?wandoo* / woodland; FMHD #2004- / 102, berl., leaf & log litter, Solodovnikov, Clarke, / *et al.* 1101 / FIELD MUS. NAT. HIST. // *Neonomius* / measured / specimen #3 / det. J. K. Liebherr 2019 // HOLOTYPE / *Neonomius* / *avonensis* / J.K. Liebherr 2019 [black margined red label]. *Paratypes*: dissected male with identical data (FMNH); dissected female with identical data. All in WAM.

Diagnosis. Adults of this species appear quite similar to those of *N. australis* based on the quadrate pronota (Figs 4, 7) and broad, foreshortened elytra but the pronotal median base is distinctly punctate in *N. avonensis*. Also unlike *N. australis*, which is characterised by a complete pronotal basal margin; the base is unmarginated medially in *N. avonensis*. This species shares with *N. baehri* the pronotal lateral seta positioned at the inner edge of the marginal depression, not on the lateral reaches of the pronotal disc as observed in *N. australis*. In keeping with the narrower elytra of this species versus *N. australis*, the elytral basal groove is very distinctly curved basad elytral striae 2-3 in this species, versus more evenly curved from the scutellum to the humerus in *N. australis*. In this species the eyes are less convex – ocular ratio 1.42-1.47 – than in *N. australis*; ocular ratio 1.47-1.56. Standardised body length ranges 3.8-4.2 mm; based on material at hand, intermediate in length between the larger *N. australis* and the smaller *N. baehri*.

Description. Head broad; ocular lobe meeting gena at nearly right angle, the juncture rounded in dorsal view; two supraorbital setae present each side; frontal groove broad at frontoclypeal suture, extended obliquely to anterior supraorbital, a transverse impression joining the two grooves posterad frontoclypeal suture; antennae moderately elongate, antennomere 9 length $1.70\times$ maximal breadth; labrum anterior margin narrowly concave medially, the margin rounded each side; mandibles elongate, length from anterior condyle $2.0\times$ distance from condyle to lateroapical margin of labrum; mentum tooth rounded, sides defining acute angle; submentum with inner and outer pairs of setae; mentum breadth $2.75\times$ length of lateral lobes; ligular apex broad, truncate, ligular setae separated by 4 setal diameters; paraglossae extended as far beyond ligular margin as distance from base to ligular margin, separated from ligula. Pronotum quadrisetose, lateral setae positioned $0.72\times$ length before hind angles; basal margin projected medially as a broadly rounded lobe, laterally basal margin sinuously concave mesad hind angle, the concavity distinctly margined; median longitudinal impression shallow, irregularly impressed on disc; anterior surface of pronotum convex, anterior margin smooth medially, broadly margined in outer $2/3$ of breadth; front angle protruded, tightly rounded, lateral marginal depression narrow from front angle posterad $0.6\times$ length toward hind angle, margin in basal $1/3$ broadly explanate, the expanded surface irregularly impressed, the margin indistinctly beaded; prosternum smooth, convex medially; prosternal process broadly margined on sides with marginal bead continued medially along ventroposterior surface of process; proepisternum smooth, suture with proepimeron deep and smooth. Elytra convex, sides meeting lateral marginal depression vertically; parascutellar striole 3-4 punctate, striole continuous between punctures, parascutellar seta present in base of sutural stria; distinctly recurved basal groove slightly punctate basad elytral striae, margin angled at humerus; 2 dorsal elytral setae present, the anterior at $1/4$ elytral length, posterior just beyond midlength; lateral elytral setae arranged as 7 anterior setae, 6 posterior setae; both subapical and apical setae present, former in stria 7, latter near elytral apex at stria 2; all elytral striae distinctly punctate, even the punctures of striae 6 and 7 connected by shallow strial elements; stria 8 deep, continuous along length, densely, distinctly punctate between anterior and posterior series of lateral setae; interval 8 elevated, subcarinate laterad subapical seta. Pterothorax foreshortened; mesepisternum smooth with 4 punctures in vertical line in deepest portion; metepisternum an equilateral trapezoid; metepimeron distinct; flight wings vestigial. Abdomen with apical ventrites smooth, suture between ventrites 1 and 2 sinuate, ventrite 2 depressed along suture; suture between ventrites 2 and 3 well developed, slightly sinuate laterally, base of ventrite 3 densely, distinctly strigose. Legs robust, femora broad medially; profemur glabrous anteriorly, with 2 setae posteroventrally; tarsomeres short, metatarsomere 1 length $0.14\times$ metatibial length, dorsolateral surface of mt1 flattened, not sulcate; metatarsomere 4 outer lobe $1.33\times$ median length. Microsculpture reduced on

head, surface glossy with indistinct transverse lines over portions of the cuticle; pronotal disc glossy but with transverse mesh, sculpticell lengths 2–3× breadth, in irregular wrinkles; elytral disc glossy, serial micropunctures visible along midline of each interval, the apex glossy with granulate microsculpture in depths of the striae.

Male genitalia. Aedeagal median lobe moderately broad basally, narrowed to a ventrally expanded, rounded tip (Fig. 28); internal sac lightly sclerotised (dissection from fully melanised male paratype) with flagellum and associated flagellar sheath present; right paramere narrow, elongate, slightly broader near midlength, ventral margin lined with about 13 short to very short setae (Fig. 31); left paramere broadest in basal third, narrowed to parallel-sided, glabrous, rounded apex.



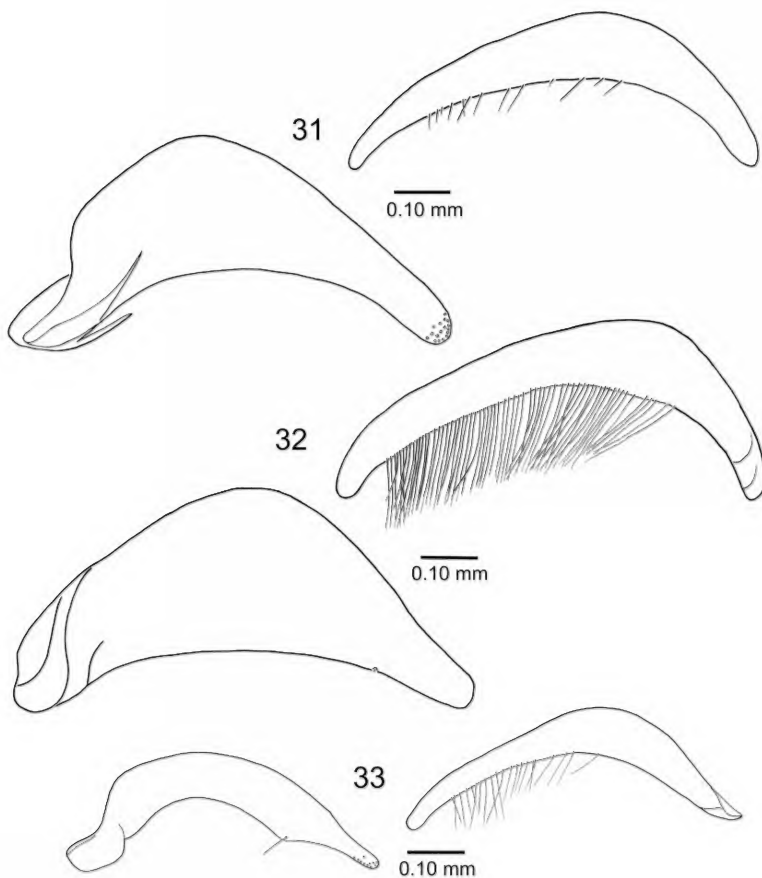
Figs 28–30. Male aedeagus, dextral view of *Neonomius* spp, anatomical dorsal surface upward: (28) *N. avonensis* **sp. n.**; (29) *N. laticollis* (teneral specimen); (30) *N. ovalis* (teneral specimen). Figure label abbreviations as in Figs 10–14.

Female reproductive tract. Bursa copulatrix elongate, length 3–4× breadth, an elongate helminthoid sclerite present at juncture of common oviduct and spermathecal base (Fig. 22); spermathecal gland duct elongate, spermatheca with elongate, sclerotised stem, spermathecal reservoir extended apically into an appendix; basal gonocoxite 1 broad, with a single very short apical fringe seta present (Fig. 34); apical gonocoxite 2 broad basally, acuminate apically,

with two very short lateral ensiform setae on the ventral surface, a moderately elongate dorsal ensiform seta and two short apical nematiform setae.

Distribution and habitat. This species is known only from the type locality in Avon Valley, Western Australia (Fig. 37). The type series of three was collected from a Berlese sample of leaf and log litter in *Eucalyptus* woodland, indicating occupation of a terrestrial, *Eucalyptus* forest-floor microhabitat.

Etymology. The species epithet is the adjectival form of the type locality; Avon Valley, northeast of Perth.



Figs 31-33. Male parameres of *Neonomius* spp, ectal view, anatomically dorsal margin upward; right paramere above left paramere in each paired drawing: (31) *N. avonensis* **sp. n.**; (32) *N. laticollis*; (33) *N. ovalis*.

isolated in this species, being well evident in the first two striae (Fig. 8) versus smaller and less crenulated striae in *N. laevicollis* (Fig. 5). Also, the eighth elytral interval is broadly convex apically in *N. laticollis* versus more elevated and subcarinate in *N. laevicollis*. Standardised body length ranges 3.5–3.9 mm. Any ambiguity regarding species diagnosis based on external characters can be instantly dispelled by examination of the male aedeagus. In this species the right paramere is lined with a luxurious brush of over 60 setae along its length (Fig. 32), as opposed to the more typical presence of about 20 shorter setae along the homologous margin in males of the externally most similar *N. laevicollis* (Fig. 18).

Male genitalia. Aedeagal median lobe (based on single dissected teneral male) broad basally, apically narrowed to ventrally expanded, rounded tip (Fig. 29); internal sac lightly sclerotised but flagellum and associated flagellar sheath traceable; right paramere parallel-sided, narrowly rounded tip down-curved and ventral margin lined with numerous setae (Fig. 32); left paramere very broad near midlength, narrowed apically to a narrowly rounded tip, ventral margin with a single very small seta near apex.

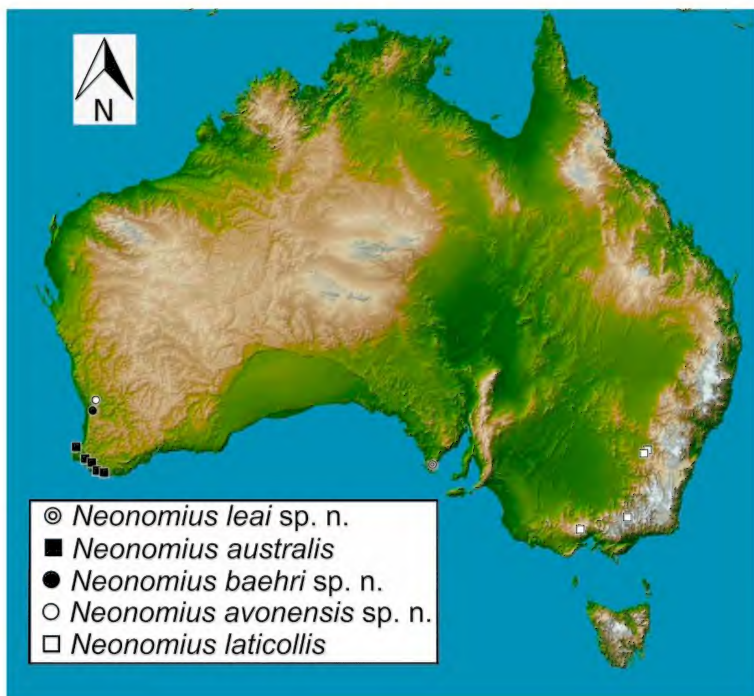


Fig. 37. Geographic localities represented by specimens of *Neonomius* spp.

Female reproductive tract. Bursa copulatrix length $3 \times$ breadth, helminthoid sclerite present at juncture of common oviduct and spermathecal base; spermathecal gland duct elongate, spermathecal reservoir with apical appendix; basal gonocoxite 1 broad, with very short apical fringe seta laterally (Fig. 35); apical gonocoxite 2 narrow basally, parallel-sided apically, with narrowly rounded tip, two short lateral ensiform setae, one short dorsal ensiform seta and two short apical nematiform setae present.

Distribution and habitat. Exhibiting a distribution including localities in New South Wales and Victoria (Fig. 37), broadly sympatric with *N. laevicollis* but at lower altitudes. Associated ecological data are sparse: the holotype was collected at Grenfell under leaves of a felled sapling, whereas a single specimen was collected in dry stream litter in Weddin Mountains N.P. (FMNH). The latter was collected by Dr Larry Watrous in association with a specimen of *Mecyclothorax peryphoides* (Blackburn) (Liebherr 2020).

***Neonomius ovalis* (Sloane)**

(Figs 9, 27, 30, 33, 36)

Mecyclothorax ovalis Sloane, 1915: 451.

Neonomius ovalis, Liebherr 2018c: 184.

Type material. *Holotype* (card mounted, destroyed), WESTERN AUSTRALIA: Manjimup, W.A. / 31.12.13 T.G.S. // *Mecyclothorax / ovalis* Sl. Type // Holotype [pink label]. Only the remains of leg apices are present in the glue on the card and so a neotype was designated (Liebherr 2018c). *Neotype* ♂, point mounted, WESTERN AUSTRALIA: Mullewa, W.A. / Sept. 19 1931 // Australia / Harvard Exp., / Darlington // MCZ // Neotype / *Mecyclothorax / ovalis* Sloane / det. J.K. Liebherr 2004 [black-margined red label]. In ANIC.

Additional material. WESTERN AUSTRALIA: Mullewa, ix-1931, Darlington (MCZ, 4), 12-ix-1931, Darlington (MCZ, 1), 20-ix-1931, Darlington (MCZ, 1), 19-ix-1951, Darlington (MCZ, 1); Wilroy, 11-ix-1931, Darlington (MCZ, 1).

Diagnosis. This small-bodied species – standardised body length 3.6-3.7 mm – can be distinguished by the moderately transverse pronotum, MPW/PL = 1.41-1.45 (Table 1), with a densely punctate, triangularly depressed median base. The line of punctures along the median base-pronotal disc juncture continues laterally as a single line of punctures along the lateral marginal depression, ending at the basal pronotal seta. Unlike the similar-appearing *N. leai* (Fig. 3), the pronotal base is broader, MPW/BPW = 1.09-1.18, and the explanate pronotal lateral margin lined with punctures is of even width near the basal seta, whereas it is much broader and smooth immediately posterad the basal seta in *N. leai*.

Male genitalia. Based on dissection of a very teneral male, aedeagal median lobe broad basally, narrowed to little extended, rounded tip, flagellum and associated flagellar sheath traceable in unverted specimen (Fig. 30); right paramere very narrow, strap-like, slightly broader near midlength, ventral

margin of apical half lined with approximately 20 moderately elongate setae (Fig. 33); left paramere moderately broad, parallel-sided but with an extended ventral projection that bears a single seta, the apex narrow with a narrowly rounded tip.

Female reproductive tract. Bursa copulatrix elongate, length 3× breadth, broad helminthoid sclerite present at juncture of common oviduct and spermathecal base (spermathecal gland assembly damaged in single dissection attempted on teneral female); basal gonocoxite 1 broad, with one elongate apical fringe seta (Fig. 36); apical gonocoxite 2 narrow basally, apex parallel-sided, either one or two lateral ensiform setae present, plus one moderately elongate dorsal ensiform seta and two elongate apical nematiform setae.

Distribution and habitat. This species was described from a single specimen collected at Manjimup, Western Australia by Sloane, with that holotype destroyed. Liebherr (2018c) designated a neotype from Darlington material collected at Mullewa, based on the criteria that: **1**, Darlington labelled his specimen as close to this species (Sloane's holotype was destroyed before Darlington could view it); and **2**, the Mullewa specimens fit Sloane's description. Further attempts to collect this species at both localities is called for to further clarify this species' identity and distribution. Sloane (1915: 451) noted that he collected his specimen 'beneath a log'.

Cladistic analysis

Parsimony analysis of the 9 taxon × 48 character matrix (Appendix 1) resulted in one tree of 98-step length (Fig. 38), this result found by either 200 or 1000 iterations of the parsimony ratchet (Nixon 1999). Using *Pterogmus rufipes* as the root to this clade, 28 character-state changes separate *Pterogmus* from the node shared by *Thayerella* and *Neonomius*. Of these, several establish the monophyly of *Thayerella* and *Neonomius* in the broader context of moriomorphine phylogeny (Liebherr 2020). These include: **1**, labrum front margin straight to only slightly emarginate (character 2, state 2); **2**, frontal grooves shallow (character 5, state 1); **3**, eyes large, covering much of ocular lobe (Figs 2-9), ocular lobe ratio 0.84-1.0 (character 10, states 1 and 2); **4**, pronotal hind angles obsolete (character 13, state 1); **5**, pronotal process apically margined (character 17, state 1); and **6**, elytral basal margin without an elevated humeral tooth. This last character was not included in the analysis as it would have represented an autapomorphy of *Pterogmus*, although in the broader context of moriomorphine phylogeny (Liebherr 2019), the loss of this tooth is a derivation shared by *Thayerella* and *Neonomius*.

Monophyly of *Neonomius* is demonstrated relative to *Thayerella newtoni* based on 15 character-state changes. Among those unreversed within *Neonomius* are: **1**, eyes large, ocular ratio 1.40-1.56 (character 9, state 1; Appendix 2); **2**, ocular lobe ratio large, 0.91-1.0 (character 10, state 2);

3, pronotal basal seta present (character 11, state 1); 4, laterobasal pronotal margin broadly explanate (character 16, state 1); 5, parascutellar striae punctate (character 21, state 1); 6, striae punctate to very punctate (character 29, states 1 and 2); 7, lateral elytral striae 5-7 or 6-7 reduced (character 26, state 1); and 8, spermatheca sessile, without duct (character 42, state 1; figs 21-22).

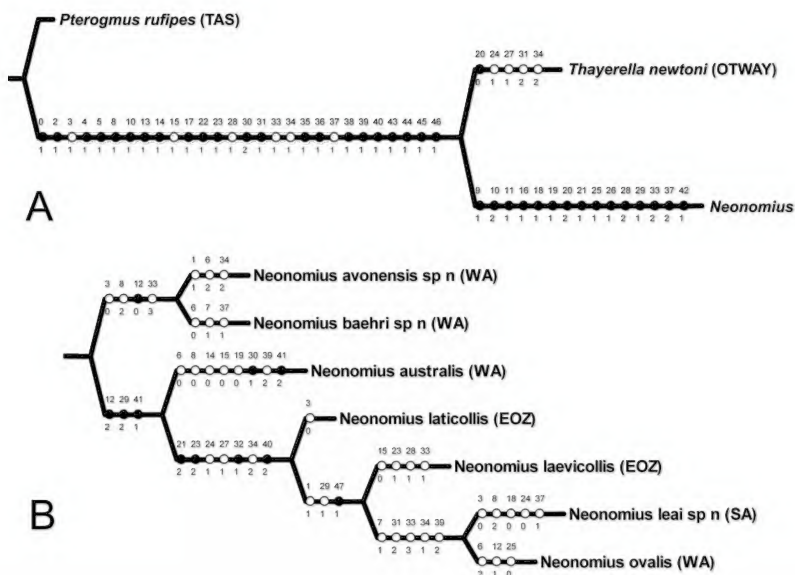


Fig. 38. Single cladogram of 98 steps derived via parsimony analysis of *Pterogmus rufipes*, *Thayerella newtoni* and seven recognised species of *Neonomius* (CI = 0.67, RI = 0.55). *Neonomius* terminal of upper cladogram A represents root of *Neonomius* phylogeny in lower part B. Character numbers shown above cladogram edges, character states below edges (Appendices 1-2). Characters are arrayed under fast optimization. Placement of character transformations on branches leading to *P. rufipes* versus *Thayerella* + *Neonomius* assumes primary *Pterogmus* outgroup separated from cladogram root by branch of zero length. Geographic areas occupied by the various species include: (EOZ) eastern Australia, including Australian Capital Territory and portions of Victoria and New South Wales; (OTWAY) Otway Ranges, Victoria; (SA) South Australia; (TAS) Tasmania; (WA) Western Australia.

Thirdly, *Thayerella* is defined cladistically in this analysis by five character-state changes, of which only the apically narrowed pronotum – APW/BPW = 0.86-0.92 (character 20, state 0) – is unique to this taxon. The four other apomorphic states are reversed within *Neonomius* allowing them to support

Thayerella as monophyletic, but only in the context of the tree. However *Thayerella* can be uniquely defined among these taxa by the autapomorphic coloration pattern that incorporates pale lateral margins contrasted with piceous pronotal and elytral discs (Fig. 2). Also symplesiomorphies shared with *Pterogmus* – including glabrous pronotal basal angle or margin (character 11, state 0), equal development of smooth striae 1-7 (characters 26 and 29, both states 0), and a stalked spermatheca (character 42, state 0) – support taxonomic placement of *Thayerella* outside of *Neonomius*.

Discussion

Generic classification. Cladistic relationships in the above parsimony analysis indicate that *Neonomius* is the monophyletic sister group to the monotypic *Thayerella*. Based on that finding, continued recognition of *Thayerella* as a valid genus is justified. Nonetheless, Williams and Ebach (2018) recently argued that monotypic genera are not monophyletic (Platnick 1976) and therefore cannot be recognised in classifications based on cladistic principles. They advocate the term aphyletic for non-monophyletic taxa including monotypic genera, with that term eschewing phylogenetic interpretation while calling for further analysis to resolve monophyly of any recognised units. This approach is rejected here based on two criteria. Firstly, were we to reject recognition of *Thayerella* because it is monotypic, we must also reject the monotypic *Pterogmus*, thereby lumping all three genera treated here under that name. Secondly, Wiley (1977) argued that monotypic genera may be monophyletic as long as the implicated species-level taxon exhibits autapomorphies that distinguish it from the common ancestor shared with its sister group. As *Pterogmus*, *Thayerella* and *Neonomius* can all be diagnosed using autapomorphies, we can accept all as both cladistically monophyletic and taxonomically diagnosable and, therefore, treat them as valid under The Code (ICZN 1999). In a review of genera described within the tribe Moriormorphini, Liebherr (2020) showed that of the 17 moriormorphine genera originally described with only a single constituent species – therefore originally monotypic – 9 genera have been converted to polytypy based on subsequent description of additional species. Transfer of *Thayerella* into Moriormorphini changes the current ratio to 9 of 18 originally monotypic genera being so converted.

Biogeography. Taxa comprising this clade are principally restricted to the south coastal regions of mainland Australia, the mountains of Victoria and New South Wales, and Tasmania (Figs 27, 37). *Pterogmus rufipes* is distributed across Tasmania, occurring up to 1200 m elevation, whereas *Thayerella rufipes* is restricted to the Otway Ranges, Victoria, being recorded from 300-525 m elevation there. *Neonomius* diversification, conversely, began in the South-West Australian area of endemism (Rix *et al.* 2015), with the sister species *N. avonensis* and *N. baehri* comprising the first divergent lineage and *N. australis* the second (Figs 27, 38). Of these, *N. avonensis* has

been collected from within leaf litter of *Eucalyptus* sp. and *N. australis* has been collected in jarrah, *Eucalyptus marginata*, and karri, *E. diversicolor*, forests and also in association with *Casuarina*. The jarrah forest of southwestern Australia was isolated from the east beginning with the Late Eocene-Early Oligocene marine inundation centred on the Nullarbor Plain and South Australia (Ladiges *et al.* 2011, Rix *et al.* 2015). This timing is proposed as the age of origin for *Neonomius*. This biogeographic hypothesis necessitates earlier occupation of the Otway Ranges by *Thayerella*, as well as pre-Oligocene occupation of Tasmania by *Pterognomus*. Rix *et al.* (2015) found two pulses of east-west dispersal and vicariance, dating isolation of southwestern Australian taxa from sister groups in southeastern Australia, first from late Eocene to mid-Miocene and subsequently from late Miocene to the Pleistocene. It is hypothesised that speciation of *N. laevicollis* and *N. laticollis* occurred after the first pulse and the ultimate isolation of *N. leai* in South Australia and *N. ovalis* in Western Australia occurred during later Plio-Pleistocene climatic oscillations.

Genitalic evolution. Reporting species-specific configurations of male insect intromittent organs is an essential feature of all modern taxonomic descriptions (Nichols 1986). Proposed causes for interspecific differences in male genitalia are many, including the generally discredited ‘lock-and-key’ hypothesis, pleiotropic interactions of genitalia-determining genes with other functional aspects of anatomy and sexual selection involving either or both female choice and sexual conflict (Eberhard 1985, 2004, Arnqvist 1997, 1998, Chapman *et al.* 2003). It is beyond the scope of this study to review the bases for male genitalic variation; however, variation in the male genitalia of *Neonomius* beetles points out a hitherto underappreciated source of genitalic variation: i.e., setation of the male parameres.

The narrow, straplike right parameres of *Thayerella* and *Neonomius* males have the ventral margin lined with a variable number of setae, these setae of varying length (Figs 16-18, 31-33). The broader left paramere is usually glabrous. Within *Neonomius*, a dramatic difference in parameral setation is observed between the two externally similar species *N. laevicollis* (Fig. 5) and *N. laticollis* (Fig. 8). The former species exhibits the more commonly observed configuration with about 20 setae lining the apical portion of the right parameral margin (Fig. 18). In stark contrast, the right paramere of *N. laticollis* (Fig. 32) is lined with up to 60 very long setae, these forming a baleen-like comb that greatly expands the tactile surface of the paramere. This configuration is analogous to that observed in males of many genera in the Broscini (Roig-Juñent 2000). The left parameres of these two species are similar, although the male of *N. laevicollis* exhibits two short setae near the parameral apex, whereas the male of *N. laticollis* has only 1 very short seta there. The parameres do not enter the female reproductive tract, but serve as tactile structures interacting with the gonocoxae, laterotergites and intervening membranes surrounding the female gonopore (Jeannel 1955,

Deuve 1993). Previously, gross configuration of the parameres has been used to support definition of major lineages within Moriormorphini (Moore 1963, Liebherr 2018b); however, the dramatic difference in parameral setation observed between these two species begs the question of how these sensillar setae might function in species-specific copulatory communication. Baehr reported similar, though not nearly as dramatic, differences in parameral setation among moriormorphine species of *Meonis* Castelnau (Baehr 2007) and *Raphetis* Moore (Baehr 2003). Within *Meonis*, setation of both the right and left parameres varied among species of the nominate subgenus (Baehr 2007, figs 1-16) with the left parameral apex variously constricted to broadly rounded. The aedeagus of *Meonis* (*Meonidius*) *uncinatus* Baehr differs from that of all species in the nominate subgenus by the glabrous and apically broadly truncate left paramere. Shape varies little among the left parameres of *Raphetis* spp, but the parameral apex has from 2-7 setae present among the various species. Intraspecific variation in parameral setation and dimensions occurs in species of the Chilean moriormorphine genus *Tropopterus* (Liebherr 2019, fig. 6). Thus both interspecific and intraspecific parameral variation occurs in this tribe. How the male parameres and their sensory structures communicate with sensilla of the female abdomen during mating remains to be elucidated but, regardless of parameral function, interspecific parameral differences serve to diagnose taxa, whereas intraspecific variation might support sexual selection based on male-female communication during mating.

Acknowledgements

This paper is dedicated to the memory of Martin Baehr. He plumbed the depths of Australian carabid beetle diversity and brought to light immense numbers of new taxa. His taxonomic revisions represent a legacy gift that will allow all of us to better understand Australian biodiversity. He also did the small things that too often go unnoticed, such as his reporting parameral configurations in male moriormorphine beetles. *Neonomius* beetles are seldom discovered in the field, so this advance is possible only due to the efforts of prior entomologists and the curators who look after their specimens. I thank the following curators for access to the specimens under their care and for their generous loans of material (for institutional codens, see Material and methods): Tom Weir and Cate Lemann (ANIC); Neal Evenhuis and James Boone (BPBM); Robert L. Davidson (CMNH); Jason Dombroskie and Corrie Moreau (CUIC); Al Newton and Margaret Thayer (FMNH); Philip D. Perkins and Crystal Maier (MCZ); Catriona MacPhee (MVM); Jan Forrest (SAMA); Brian Hanich and Nik Tatarnic (WAM); Alexey Solodovnikov (ZMUC); Martin Baehr† and Michael Balke (ZSM). I sincerely thank David R. Maddison, Oregon State University, Corvallis, for sharing his information on *Thayerella* phylogenetic relationships. Al Newton is thanked for explaining the flight-intercept trap configuration used during the Field Museum's entomological sampling in Australia.

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Appendix 1

Data matrix for cladistic analysis of *Neonomius* spp and phylogenetic affiliates. Characters numbered 0-47 as in Appendix 2 and Fig. 38. Polymorphic characters indicated by letter codes: polymorphic for states 0 and 1 (A); polymorphic for states 1 and 2 (B). Geographic areas occupied by species include: EOZ, southeastern Australia; OTWAY, Otway Ranges, Victoria; SA, South Australia; TAS, Tasmania; WA, Western Australia.

Character number	000000000011111111112222
	012345678901234567890123

Taxon	
<i>Pterogmus rufipes</i> (TAS)	000000100000100000001000
<i>Thayerella newtoni</i> (OTWAY)	101111101010111101000011
<i>Neonomius australis</i> (WA)	101111000121210011102111
<i>N. avonensis</i> sp. n. (WA)	1110112021210111111A2111
<i>N. baehri</i> sp. n. (WA)	101011012121011111112111
<i>N. laevicollis</i> (EOZ)	11111110112121A011112211
<i>N. laticollis</i> (EOZ)	1010111011212111111A2212
<i>N. leai</i> sp. n. (SA)	111011112121211111012212
<i>N. ovalis</i> (WA)	11111121112111111111B212

Character number	222222333333333344444444
	456789012345678901234567

Taxon	
<i>P. rufipes</i> (TAS)	000000000000000000000000-
<i>T. newtoni</i> (OTWAY)	100110220121111110011110
<i>N. australis</i> (WA)	011022110211121212111110
<i>N. avonensis</i> sp. n. (WA)	011021210321121110111110
<i>N. baehri</i> sp. n. (WA)	011021210311111?????????
<i>N. laevicollis</i> (EOZ)	111111211121121121111111
<i>N. laticollis</i> (EOZ)	111122211221121121111110
<i>N. leai</i> sp. n. (SA)	011121221311111?????????
<i>N. ovalis</i> (WA)	101121221311121221111111

Appendix 2

Character-state definitions for characters 0-47 supporting cladistic parsimony analysis. All characters are ordered except Character 39.

Character 0. Antennomeres 2 and 3: (0) setose in apical half; (1) glabrous.

Character 1. Antennomere 9 length/breadth ratio: (0) 1.80-1.84; (1) 1.50-1.71.

Character 2. Labrum apical margin: (0) broadly moderately concave; (1) slightly concave to straight.

Character 3. Mandibular length ratio: (0) 1.73-2.0; (1) 1.28-1.64.

Character 4. Maxillary stipes setation: (0) 1 basal seta, 1 more apical; (1) 2 basal setae, 1 more apical.

Character 5. Frontal grooves: (0) deep, narrow, convergent; (1) shallow, circular depression near fronto-clypeal suture.

Character 6. Ocular lobe: (0) projected, juncture with gena ~right; (1) projected, juncture with gena obtuse little projected.

Character 7. Ligular apex: (0) broadly rounded; (1) truncate.

Character 8. Ligular setae: (0) separated by 2 setal diameters; (1) separated by 3 setal diameters; (2) separated by 4 setal diameters.

Character 9. Ocular ratio: (0) 1.32-1.38; (1) 1.40-1.56.

Character 10. Ocular lobe ratio: (0) 0.52-0.76; (1) 0.84-0.89; (2) 0.91-1.0.

Character 11. Pronotal basal seta: (0) absent; (1) present.

Character 12. Pronotal lateral seta position: (0) in marginal depression; (1) adjacent to marginal depression; (2) 1 setal diameter mesad marginal depression.

Character 13. Pronotal hind angles: (0) slightly obtuse, angulate; (1) rounded to obsolete.

Character 14. Pronotal median base: (0) smooth; (1) strigose to punctate.

Character 15. Pronotal base: (0) completely margined across breadth; (1) unmargined medially, beaded laterally.

Character 16. Pronotal laterobasal margin: (0) narrowly beaded or upraised; (1) broadly explanate.

Character 17. Prosternal projection: (0) unmargined; (1) distinctly beaded on posterior margin of ventral face.

Character 18. Pronotal base: (0) constricted, $MPW/BPW = 1.19-1.29$; (1) relatively broader, $MPW/BPW = 1.05-1.18$.

Character 19. Pronotal breadth: (0) moderately transverse, $MPW/PL = 1.28-1.37$; (1) transverse, $MPW/PL = 1.38-1.52$.

Character 20. Pronotal apical to basal breadth (APW/BPW): (0) 0.86-0.92; (1) 0.77-0.81; (2) 0.59-0.76.

Character 21. Parascutellar striole: (0) smooth, a continuous groove; (1) 3-4 punctures in shallow groove; (2) 2-4 isolated punctures, striole discontinuous.

Character 22. Dorsal elytral seta number: (0) 3; (1) 2.

Character 23. Apex of elytral interval 8 laterad stria 7: (0) carinate; (1) narrowly subcarinate convex to broad, flat.

Character 24. Elytral convexity: (0) convex, sides sloped to near vertical; (1) moderately convex, sides sloping to margin.

Character 25. Elytral humeri: (0) obtuse angulate; (1) narrowly rounded to rounded.

Character 26. Elytral striae: (0) all present, well developed; (1) all present but 5-7 or 6-7 reduced.

Character 27. Elytra: (0) conjoined at apex; (1) not conjoined.

Character 28. Elytral stria punctures: (0) absent; (1) present, small deep, circular, isolated;

Character 29. Eighth elytral stria: (0) smooth, deep at midlength; (1) continuous but minutely punctate at midlength; (2) discontinuous, deep, isolated punctures medially.

Character 30. Elytral lateral marginal depression: (0) moderately broad throughout length; (1) narrow anteriorly, broader posterad narrow throughout length.

Character 31. Elytral subapical sinuation: (0) evident in dorsal view; (1) broadly, slightly concave obsolete, margin convex.

Character 32. Elytral dimensions (MEW/EL): (0) 0.70-0.75; (1) 0.63-0.68.

Character 33. Mesepisternum: (0) broadly punctate, ~16 punctures in 4 vertical rows; (1) punctate, ~12 punctures in 3 vertical rows; (2) punctate, 6-7 punctures in 1-2 vertical rows; (3) smooth, 4 punctures in 1 vertical row.

Character 34. Apex of metasternal process: (0) broadly rounded; (1) broadly triangular; (2) narrow, knobbed.

Character 35. Vertex microsculpture: (0) evident, isodiametric; (1) indistinct transverse mesh in parts, surface glossy.

Character 36. Pronotal discal microsculpture: (0) transverse mesh to transverse lines; (1) indistinct transverse mesh in parts, surface glossy.

Character 37. Elytral microsculpture: (0) elongate transverse mesh and transverse lines; (1) indistinct transverse mesh in parts, surface glossy; (2) without visible mesh, surface glossy.

Character 38. Standardised body length (mm): (0) 5.2-6.8; (1) 3.4-4.7.

Character 39. (–) Male aedeagal median lobe apex: (0) broad, blunt; (1) broadly rounded, apex expanded dorsoventrally; (2) rounded, narrow, apex not expanded dorsoventrally.

Character 40. Male right paramere ventral marginal setae: (0) < 10 setae; (1) 12-17 setae; (2) 20-62 setae.

Character 41. Male left paramere ventral marginal setae: (0) none, margin glabrous; (1) 1-2 short setae; (2) 1-10 elongate setae.

Character 42. Female spermatheca: (0) stalked, duct longer than spermathecal reservoir; (1) duct shorter than spermathecal reservoir.

Character 43. Female spermathecal gland duct length: (0) moderate; (1) elongate.

Character 44. Female spermathecal gland: (0) bipartite, basal and apical reservoirs connected by long duct; (1) unipartite, a single elongate reservoir plus short appendix present.

Character 45. Female bursa copulatrix: (0) 2-3× long as broad; (1) 3-4× long as broad.

Character 46. Female basal gonocoxite 1: (0) glabrous; (1) with single apical fringe seta.

Character 47. Gonocoxite 1 apical fringe seta (state 1 of #46): (0) short; (1) elongate (taxon scored 0 for #46 assigned state ?).

THE FIRST CONFIRMED RECORDS OF THE SUBFAMILY TRIGONOMIMINAE (DIPTERA: ASILIDAE) FROM AUSTRALIA AND PAPUA NEW GUINEA, WITH THE DESCRIPTION OF TWO NEW SPECIES OF *DAMALINA* DOLESCHALL

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Abstract

Damalina mcalpinei **sp. n.**, the first record of the asilid subfamily Trigonimiminae from Papua New Guinea, is described. A second species, *D. burwelli* **sp. n.** is described from near Atherton, northern Queensland, the first confirmed record of the subfamily from Australia. Both species are illustrated and compared with the description of *Damalis fuscipennis* Macquart, a species recorded as from ‘Nouvelle-Hollande’ and only known from the original description. A key to the two genera and three species recorded from the two countries is provided. The presence of ommatrichia is recorded in the subfamily for the first time.

Introduction

The asilid subfamily Trigonimiminae, with eleven genera (Geller-Grimm 2004), is known from six of the eight major zoogeographical regions (Olsen *et al.* 2001) and has the highest diversity in the Afrotropical and Indomalayan Regions (Geller-Grimm 2004).

Two genera, *Damalis* Fabricius and *Damalina* Doleschall, have been recorded from the Australasian Region (Daniels 1989). Within the Region, *Damalina*, with one species, is known only from Ambon Island, Indonesia, while two species of *Damalis* are also known with certainty only from Indonesia. A third *Damalis* species, *D. fuscipennis* Macquart, was described from ‘Nouvelle-Hollande’ (= Australia) by Macquart (1846) and is the only record of the subfamily from Australia. The type specimen was deposited at Musée d’histoire naturelle de Lille, France (Macquart: ‘Ma Collection’), but this collection is badly damaged (Evenhuis *et al.* 2016) and the type is assumed to have been destroyed.

The French dipterist Pierre-Justin-Marie Macquart was notorious for providing insect descriptions bearing incorrect type localities, particularly species from ‘Tasmanie’ (e.g. Hardy 1929, Paramonov 1950, Pont 1967, Crosskey 1971) but he was not alone in doing this. However, in this instance, there is no evidence to suggest that the published type locality of ‘Nouvelle-Hollande’ is incorrect, despite the species having never been collected since.

The most recent revision of the Trigonimiminae closest to the Australasian Region was by Oldroyd (1972: 254), which dealt with the fauna of the Philippines, where three genera occur: *Damalis* (as *Xenomyza* Wiedemann), *Damalina* and *Trigonimima* Enderlein. Oldroyd recorded seven species of *Damalis* (as *Xenomyza*), of which two were new, and a single species in each of the remaining genera. He also provided excellent illustrations for characters enabling separation of the three genera.

Table 1. *Damalis fuscipennis* (from characters presented in Macquart’s description) is compared with *Damalina burwelli* **sp. n.** and *D. mcalpinei* **sp. n.** It must be noted some characters that were briefly mentioned in the Latin diagnosis of *D. fuscipennis* were expanded upon in the description and read with slight differences. Hence, in the Latin diagnosis the thorax is described as ‘Thorace flavo, vittis nigris’ [Thorax yellow, with black vittae] but in the expanded description it is ‘Thorax à duvet doré et bandes noires’ [Thorax golden tomentose with black bands].

	<i>Damalis fuscipennis</i>	<i>Damalina burwelli</i>	<i>Damalina mcalpinei</i>
Mystax	white	black	black
Antennae	black	black	black
Thorax	golden tomentose with black vittae	brownish tomentose without vittae	brownish tomentose without vittae
Legs	red; black hips; thighs with a black tip; posterior to tape black outer; two rows of black tips; legs at end black; black tarsi	black to deep brown, tarsi yellow-brown	orange-brown
Wings	brown, especially at the outer edge; yellow base	uniformly brown	uniformly brown
	venation as in <i>Damalis tibialis</i> (Macquart’s illustration of <i>D. tibialis</i> shows cell cup closed); outer basal cell extending up to three quarters of the discoidal	cell cup open	cell cup open
Abdomen	Red, the first two segments of a clear fawn: the others are missing	black to deep brown	black, tergites 1-3 grey pollinose
Length	4 lines [9.0 mm] (but abdomen is broken)	ca 9.5 mm	7.8 mm

Methods and terminology

Specimens were examined under a Zeiss Stemi SV6 microscope and characters were measured with an ocular micrometre. Morphological terminology follows Geller-Grimm (2015) and Dikow (2009). Specimens were photographed at sequential focal planes and images edited with Photoshop CS6 software. Images were prepared using either a Panasonic Lumix DMC-GX85 camera fitted with a 60 mm focal length macro lens or a Canon EOS 7D Mark II camera. Images were then compiled with either CombineZP stacking software or Zerene stacking software.

The holotype label data are quoted exactly as they appear. A slash (/) denotes the commencement of a new line, two slashes (//) beginning or ending of data on a label.

Taxonomy

Subfamily Trigonomiminae

The subfamily is recognised by having well developed, conspicuous, anteroventrally positioned, anterior tentorial pits (Fig. 10), an autapomorphy supporting monophyly of the subfamily. Two excellent ‘spot characters’ for this subfamily are the exceptionally wide and narrow head, combined with a low vertex, leaving a ‘goggle-eyed’ aspect (Fig. 10); and the greatly enlarged anterior eye facets (Fig. 10). It has two tribes, Trigonomimini and Xenomyzini. Both *D. burwelli* **sp. n.** and *D. mcalpinei* **sp. n.** have cell cup open and the postpedicel long and broad with a long apical style, characters that place the genus in the tribe Trigonomimini. As *Damaliscus fuscipennis* has cell cup closed, that species is placed in the Xenomyzini.

Key to Australian and New Guinean taxa of Trigonomiminae

1. Cell cup open; postpedicel elongated, laterally compressed and with a long style and a short, apical spine (Fig. 4) (Trigonomimini)
..... *Damaliscus* Doleschall ... 2
- Cell cup closed; postpedicel small, seed-like, with a long, thin style (Xenomyzini) *Damaliscus* Fabricius
2. Legs black to deep brown, tarsi yellow-brown; abdomen black to deep brown; segments 2 and 3 narrower than segment 4 (Australia, Qld)
..... *Damaliscus burwelli* sp. n.
- Legs orange-brown; abdomen black, tergites 1-3 grey pollinose; segments; segments 1-4 of similar width (Papua New Guinea)
..... *Damaliscus mcalpinei* sp. n.

Damaliscus Doleschall

Damaliscus Doleschall, 1858: 90. Type species: *Damaliscus laticeps* Doleschall, 1858, by monotypy.

Diagnosis. Head unusually flat and wide, with large, prominent eyes; scape short; pedicel about twice as long as scape; postpedicel long, with groups of truncate setae and bearing a long, thin style; mesonotum moderately arched, devoid of macrosetae; scutellar disc with only long thin setae, marginal macrosetae absent; hind femur weakly clavate with some stout pre-apical ventral setae.

Distribution. Oriental and Australasian Regions.

Discussion. The Australian and New Guinean *Damaliscus* species can be recognised by the small scape and long, laterally compressed postpedicel with a dorsal, apical spine and long thin style (Figs 4, 18); the mesonotum is weakly arched both anteriorly and posteriorly; the hind femur is weakly clavate; the wings are uniformly brown and cell cup is widely open.

***Damalina burwelli* sp. n.**

(Figs 1-12)

Type material. Holotype ♀, QUEENSLAND: // NEQ:17°07'S 145°34'E / Kauri Ck, Lamb Range / 1190 m 27Nov1998 / C.J. Burwell rainforest / mv lamp 50026 // QM Reg. No. / T245908 // in Queensland Museum, Brisbane.

Description. Dimensions. Length (mm): body, 9.5; thorax (including scutellum), 2.3; wing, 7.8.

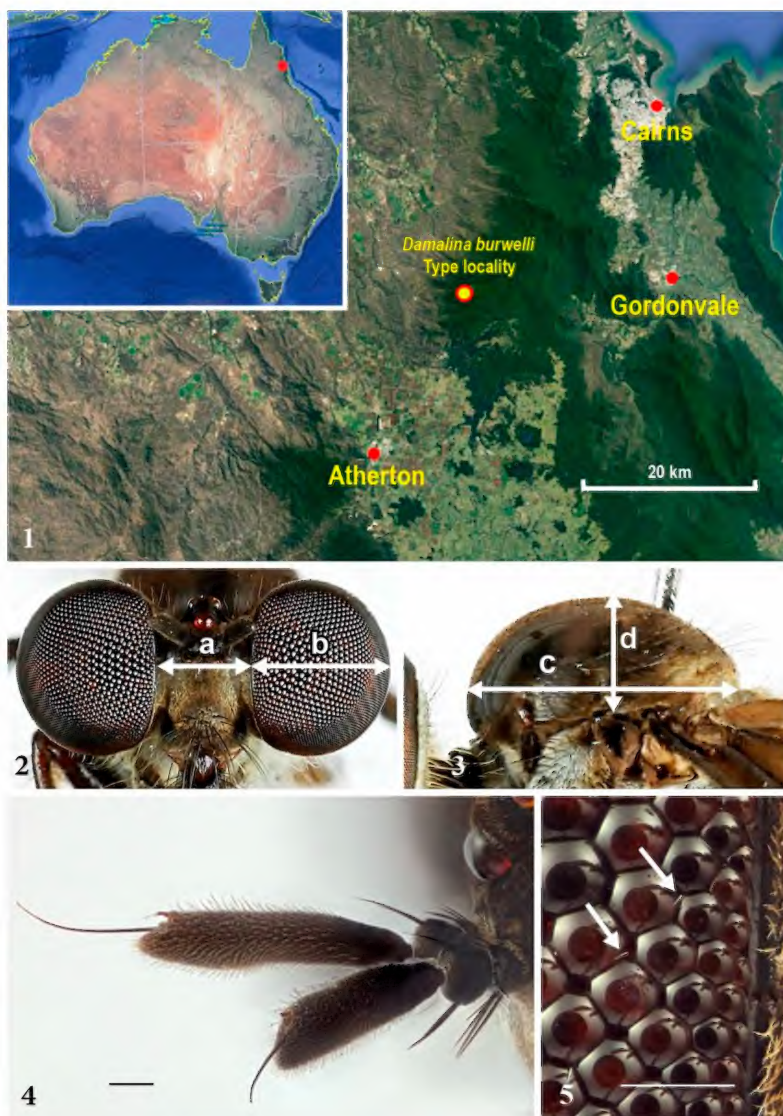
Head (Figs 10-12) black, coppery to brownish tomentose. Antennal setae black, confined to dorsal and ventral margins of scape and pedicel; antennal sockets abutting; postpedicel long, its maximum width 0.2x length, densely covered with short setae and bearing a short, dorsal apical spine; inner surface with stouter, semi-opaque, truncate setae; style long and thin. Eye: face width ratio = 2.6: 1.8 (Fig. 2). Face viewed laterally following contour of eye; ocellar tubercle coppery tomentose; a pair of long, black, slightly proclinate ocellar setae. Eye with sparse, inconspicuous ommatrichia mostly limited to the first four rows of ommatidia along facial margin (Fig. 5) and numbering three per 21 ommatidia on one sampled eye area. Mystax composed of numerous, well spaced, long, black setae on a small tubercle on lower facial margin. Palpi black, slender and with black setae. Occiput yellowish grey tomentose, with scattered, fine black setae dorsally and similar pale setae ventrally; gena with a few weak setae.

Thorax (Figs 6-7) black; scutum brownish tomentose, scutellum grey-brown tomentose, lateral sclerites white tomentose; major scutal setae not clearly differentiated apart from a stout notopleural; scutellar disc with long, fine, black setae; anepisternum and katatergite with long, fine black setae; proepisternum and proepimeron with long, fine yellow setae. Length: height ratio of scutum = 9.9: 4.8 (Fig. 3). Postmetacoxal bridge complete. Haltere pale brown.

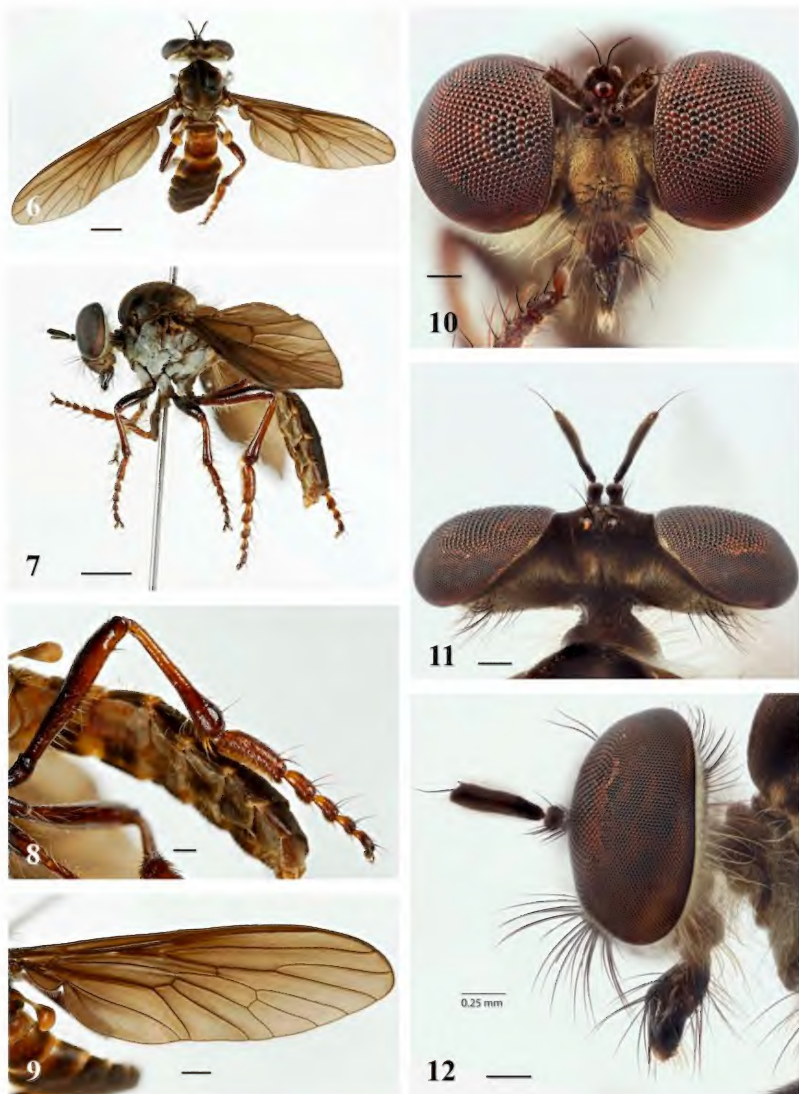
Wings (Fig. 9) brown, with uniformly distributed microtrichia; all marginal cells open.

Legs shining red-brown, femora black, at least dorsally; stout macrosetae absent, numerous long setae present on femora and tibiae. Hind femur (Fig. 8) slightly clavate distally; tibiae clavate distally and best developed on hind tibia; hind tarsomere 1 swollen.

Abdomen (Figs 6-7) with segments 1 and 2 narrow; segment 3 much wider, segment 4 slightly wider than 3, remaining segments tapering to segment 9; tergites dark brown, tergites 1-3 with varying pale brown areas and tergite 9 yellow brown; obvious golden setae present laterally on tergites 2 and 3, remaining tergites with scattered short setae. Sternites 2 and 3 pale brown, remaining sternites dark brown with pale posterior margins.



Figs 1-5. *Damalina burwelli* sp. n., holotype: (1) map showing type locality; (2-3) measurements for calculation of ratios: (2) eye: face width – a = face width, b = eye width; (3) scutum length: height – c = length, d = height; (4) antennae; (5) eye with ommatrichia. Scale bars (Figs 4-5) = 0.1 mm.



Figs 6-12. *Damalina burwelli* sp. n., holotype ♀: (6) habitus, dorsal view; (7) habitus, lateral view; (8) hind leg, lateral view; (9) wing; (10) head, anterior view; (11) head, dorsal view; (12) head, lateral view. Scale bars: Figs 6-7 = 1 mm; Figs 8, 10-12 = 0.25 mm; Fig. 9 = 0.5 mm.

Etymology. The species is named for Chris Burwell, collector of the only known specimen.

Distribution (Fig. 1). Known only from the type locality in northern Queensland. According to label data, *Damalina burwelli* was collected in the Lamb Range (17°07'S 145°34'E). More precise GPS coordinates are – 17.1108°S 145.5678°E at the head of Kauri Creek, close to the highest point of the Lamb Range (G.B. Monteith pers. comm., one of the collectors present on the occasion the holotype was collected).

***Damalina mcalpinei* sp. n.**

(Figs 13-20)

Type material. Holotype ♂, PAPUA NEW GUINEA: // Woitape, Wharton / Ra. Papua 10 Oct / 1963 D.K.McAlpine // Australian Museum / K 46777 // in Australian Museum, Sydney.

Description. Dimensions. Length (mm): body, 7.8; thorax (including scutellum), 1.9; wing, 6.8.

Head (Fig. 16) with antennal setae black, confined to dorsal and ventral margins of scape and pedicel; antennal sockets abutting; postpedicel long, ventrally rounded distally, its maximum width 0.3x length, sparsely covered with short setae and bearing a very short, apical spine; dorsally with stouter, semi-opaque, truncate setae; style long and thin, arising subapically on anterior surface. Eye: face width ratio = 4.2: 3.1 (Fig. 2). Face with pale brown tomentum; viewed laterally following contour of eye, projecting slightly on lower face; ocellar tubercle coppery tomentose; a pair of proclinate, black ocellar setae. Eye with very sparse, inconspicuous ommatrichia mostly limited to the midpoint between middle of eye and facial margin and numbering three per 29 ommatidia on one sampled eye area. Mystax composed of numerous, well spaced, long, black setae on a small tubercle on lower facial margin. Palpi yellow-brown, slender and with yellow-brown setae. Occiput grey tomentose, with scattered, fine, almost transparent setae dorsally and ventrally; gena with a few weak setae.

Thorax yellow-brown; scutum black with brownish tomentum, which becomes paler posteriorly, scutellum grey-brown tomentose, lateral sclerites white tomentose apart from anepisternum which has yellow tomentum; major scutal setae not clearly differentiated apart from a relatively stout notopleural; scutellar disc without setae; anepisternum with white setae and a single long, black seta near posterior margin katatergite with long, fine white setae; proepisternum and proepimeron with long, fine white setae. Length: height ratio of scutum = 8.5: 3.4 (Fig. 3). Postmetacoxal bridge complete. Halter with a pale brown stem, dark at base of knob and remainder of knob white.

Wings brown, with uniformly distributed microtrichia; all marginal cells open.



Figs 13-20. *Damalina mcalpinei* sp. n., holotype ♂: (13) map of the island of New Guinea showing type locality; (14) habitus, lateral view; (15) hind leg, lateral view; (16) head, anterior view; (17) antenna; (18-20) terminalia: (18) dorsal view; (19) lateral view; (20) ventral view. Scale bars: Fig. 14 = 1 mm; Fig. 15 = 0.5 mm; Fig. 16 = 0.25 mm; Figs 17-20 = 0.1 mm.

Legs shining orange-brown; stout macrosetae absent, numerous long setae present on femora and tibiae. Hind femur (Fig. 15) slightly clavate distally; tibiae clavate distally and best developed on hind tibia; hind tarsomere 1 swollen.

Abdomen parallel-sided, segment 8 tapered; tergites dark brown, tergites 1-3 greyish tomentose; tergite 4 greyish on basal half; tergites 2 and 3 with fine, white setae laterally; remaining tergites mostly devoid of setae. Sternites yellow, darkening posteriorly and with yellow posterior margins.

Terminalia (Figs 18-20). Epandrium brownish, remainder orange-yellow. Epandrium long, narrow, parallel-sided; ventrally curved distally; hypandrium triangular in ventral view; gonocoxite robust, longer than hypandrium; gonostylus long, narrow, setose on inner margin, about half as long as epandrium.

Etymology. The species is named for David McAlpine, collector of the only known specimen.

Distribution (Fig. 13). Known only from the type locality in the Southern Region, Central Province, Papua New Guinea.

***Damalis fuscipennis* Macquart**

Damalis fuscipennis Macquart, 1846: 223 [95]; Walker 1855: 765; Kertész 1909: 94; Ricardo 1912: 159; Hardy 1934: 35; Hull 1962: 55; Daniels 1989: 336.

Macquart's description reads:

'5. *Damalis fuscipennis*, Nob.

Thorace flavo, vittis nigris. Abdomine rufo. Mystace albedo. Antennis nigris. Pedibus rufis. Alis fuscis.

Long. 4. l. Barbe, face, moustache et front d'un blanc jaunâtre. Antennes noires. Thorax à duvet doré et bandes noires. Abdomen: les deux premiers segments d'un fauve clair: les autres manquent. Pieds: hanches noires; cuisses à extrémité noire; postérieures à bande extérieure noire; deux rangs de pointes noires; jambes à extrémité noire; tarses noirs. Ailes brunes, surtout au bord extérieur; base jaune; nervures comme dans le *D. tibialis*; cellule basilaire externe s'étendant jusqu'aux trois quarts de la discoïdale.

De la Nouvelle-Hollande. Ma collection.'

Translation:

5. *Damalis fuscipennis*, New.

Thorax yellow with black vittae. Abdomen red. Moustache white. Antennae black. Feet red. Wings dark.

Length 4 lines [9.0 mm]. Beard, face, moustache and forehead yellowish-white. Antennae black. Golden downed thorax and black bands. Abdomen: the first two segments of a clear fawn: the others are missing. Feet: black hips; thighs with a

black tip; posterior to tape black outer; two rows of black tips; legs at end black; black tarsi. Wings brown, especially at the outer edge; yellow base; veins as in *D. tibialis*; outer basal cell extending up to three quarters of the discoidal.

From New Holland. My collection.

Comments. No new information has become available for this species since it was described; all subsequent references partially reiterate what had been recorded previously by Macquart. Ricardo (1912: 159) gave no indication she had examined the holotype but speculated that the species was allied to *D. pandens* Walker from the Celebes.

Macquart gave a body length of 4 lines (= 9 mm) but the specimen would have been much larger because, according to his description, abdominal segments 3 and beyond were missing.

Acknowledgements

I thank Geoff Thompson (Queensland Museum) for assistance with photography, the Queensland Museum for providing research facilities and Russel Cox for the loan of material in the Australian Museum, Sydney.

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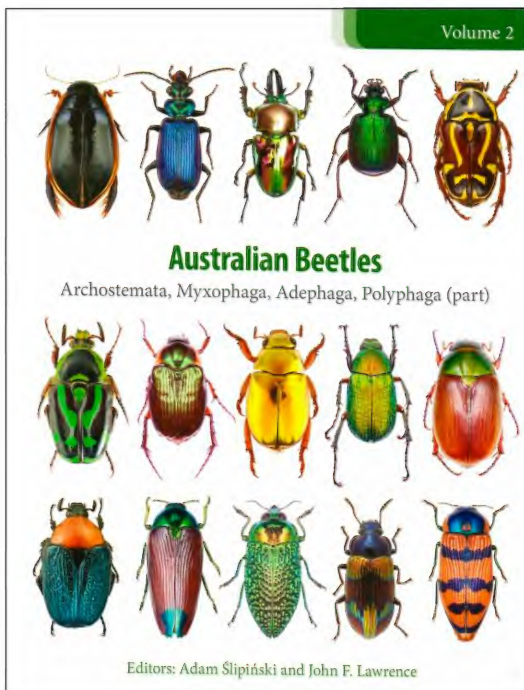
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BOOK REVIEW

Australian Beetles Volume 2: Archostemata, Myxophaga, Adephaga, Polyphaga (part). Edited by Adam Ślipiński and John F. Lawrence. 792 pp., CSIRO Publishing, Clayton, Melbourne, 2019. Price: Hardback \$250, available from <https://www.publish.csiro.au/book/6523> with links to e-book suppliers.



The publishing of great works are major intellectual milestones in any discipline. In Australian entomology during my lifetime the appearance of the 1970 1st Edition of CSIRO's *Insects of Australia* was one of those. At that time, Tillyard's classic 1926 *The Insects of Australia and New Zealand* was long out of date and at UQ Entomology Department we taught Australian insects from an uninspiring British book by Imms called *A General Textbook of Entomology*. Everyone in the Department had the new CSIRO book on pre-order at the UQ Bookshop. When the phone call came announcing 'the books are here!', I literally ran across the Great Court to bring everyone's copies back, then had to put the 30 kg carton down several times on the return trip, giving literal meaning to 'the weight of knowledge'. The turmoil and excitement of delivering the books to their owners was followed by hours of silence as everyone retreated to their room to leaf through the wondrous tome. Similar events accompanied the appearance of the completely revised 2-volume 2nd Edition of *Insects of Australia* in 1991 and of Michael Braby's 2-volume *Butterflies of Australia* in 2000.

Continued on page 248

**A RECORD OF *JUNONIA ERIGONE TRISTIS* (MISKIN, 1890)
(LEPIDOPTERA: NYMPHALIDAE) FROM MER ISLAND, TORRES
STRAIT, QUEENSLAND AND A BRIEF DISCUSSION OF
BUTTERFLY VAGRANCY ON THE ISLAND**

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Abstract

A single male *Junonia erigone* (Cramer, [1775]) is recorded from Mer (Murray) Island, Torres Strait. The specimen is illustrated and compared with the subspecies from Flores, Timor and Papua New Guinea and is thought to be a vagrant *J. e. tristis* (Miskin, 1890) from southern PNG. Based on the theory of island biogeography, the number of butterfly taxa (100) recorded from Mer seems high considering its small size (including its two satellite islands), its remoteness from mainland PNG and Queensland and in comparison with the fauna of some Torres Strait islands that are close to mainlands. This suggests a large proportion of these taxa should be vagrant and not established on the island. Analysis indicated that at least 8 of these taxa are considered vagrant and therefore it is proposed that a considerable number of vagrant butterflies fly over water in Torres Strait and regularly arrive on islands such as Mer, despite its remoteness. A study of the temporal appearance and persistence of the Hamadryad butterfly, *Tellervo zoilus digulica* Hulstaert, 1924, on Mer Island indicated that this population likely originated from vagrant butterflies blown onto the island in the early 1990s from the southern lowlands of New Guinea near the Indonesian Papua/PNG border, approximately 285-350 km northwest of Mer.

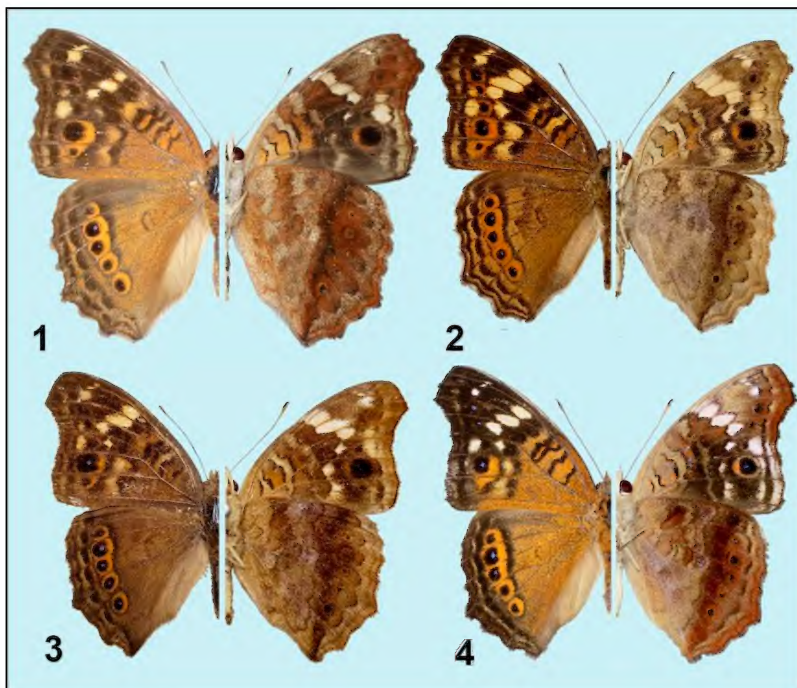
Introduction

The Northern Argus, *Junonia erigone* (Cramer, [1775]) is a tropical species occurring widely from Java and Bali, through the Lesser Sunda Islands, Sulawesi, Timor and its surrounding islands, Aru and New Guinea (Tsukada 1985). To date, in Australia just one specimen has been recorded (a female) from Rimbija in the Wessel Islands, Northern Territory (Edwards 1977). This specimen was considered a vagrant from Timor (Braby 2000), i.e. *J. e. walkeri* (Butler, 1901). Close to Australia, *J. e. persiccata* Fruhstorfer, 1912 (Fig. 1) is known from Sumbawa, Flores and Sumba, *J. e. tristis* (Miskin, 1890) from southern Papua New Guinea (PNG) and *J. e. walkeri* (Figs 2-3) from Timor (Tsukada 1985, Parsons 1998). In January 2016, a single male *J. erigone* was collected on Mer (= Murray) Island, Torres Strait flying along the edge of semi-deciduous monsoon forest. This paper reports on the collection of this specimen, its identity and its probable source. In addition, the vagrancy of butterflies on Mer Island is briefly discussed.

Discussion

The male collected on Mer Island (Fig. 4) is unlike those known from Flores in the Lesser Sunda Islands (Fig. 1) and from Timor (Figs 2-3) and is more like *J. e. tristis* from southern PNG, with pale cream subapical bars and spots on the upperside of the forewing (Fig. 4), which is a diagnostic feature of *J. e. tristis* (Barret and Burns 1951, Parsons 1998). The two subspecies from Flores (Fig. 1) and Timor (Figs 2-3) have brown margins on the upperside of the wings, as opposed to the black margins in *J. e. tristis* (Fig. 4), while the

subapical markings are dark yellow or orange, not white as in *J. e. tristis* (Fig. 4). *Junonia e. persiccata* from Flores (Fig. 1) is noticeably larger than both *J. e. walkeri* (Figs 2-3) and *J. e. tristis* (Fig. 4).



Figs 1-4. *Junonia erigone* ♂♂ (all figures to scale, upperside left, underside right): (1) *J. e. persiccata*, Labuan Bajo, Flores, Indonesia, 28.x.2010, T.A. Lambkin [forewing length 28 mm]; (2-3) *J. e. walkeri*, (2) Maliana, 230 m, Timor Leste, 23.xi.2018, T.A. Lambkin [23 mm], (3) Saburai District, 900 m, 9 km SSW of Maliana, Timor Leste, 10.xii.2017, T.A. Lambkin [25 mm]; (4) *J. e. tristis*, Mer Is., Torres Strait, Qld, 27.i.2016, T.A. Lambkin [25 mm].

The collection of this lone specimen of *J. e. tristis* on Mer Island (Fig. 4) prompts the question: how frequent are butterfly vagrants in Torres Strait and specifically on Mer Island? Mer lies in the far east of the Strait and thus is the most remote of the Torres Strait islands, with ocean distances to the Queensland and PNG mainlands being 181.5 km and 124.5 km respectively (Fig. 5). The vegetation on Mer is dense, consisting of semi-deciduous monsoon vine forest intermingled with village garden plants, numerous coconut groves and naturalised species (Fig. 6). Despite its remoteness and not being a particularly large island (4.3 km²), it is remarkable that a

substantial number of butterfly taxa (100: TAL unpublished data) have been collected on Mer. Vagrants are considered here to be taxa that are potential colonisers (MacArthur and Wilson 1967) known only from a few specimens, or taxa that have been recorded over a single and short discrete period and are not considered to breed permanently on the island. The interchange of species between PNG and Cape York Peninsula across the Torres Strait archipelago is poorly known and understood (Kikkawa *et al.* 1981).

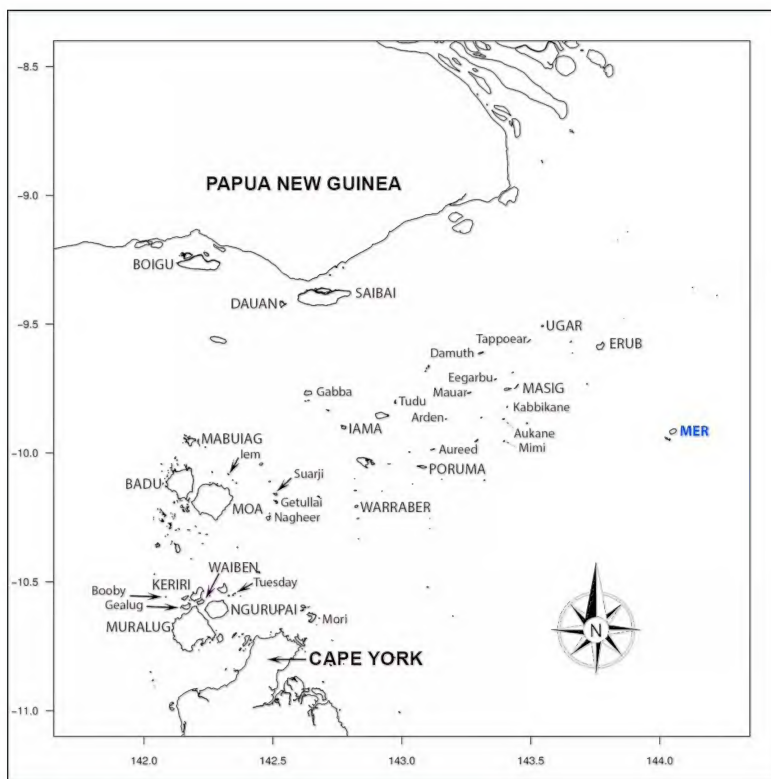


Fig. 5. Map of Torres Strait, Queensland: Mer Island is indicated in blue; positions of Bensbach and Morehead Rivers, southern PNG are to the left of the map at 9°S.

Thus, on Mer Island, the most notable taxa that are likely vagrants are *Papilio ambrax ambrax* Boisduval, 1832 (Wood 1987), *Parthenos tigrina cynailurus* Fruhstorfer, 1915 (Meyer *et al.* 2016), *Euploea alcathoe misenus* Miskin, 1890 (Lambkin and Knight 1990), *E. modesta lugens* Butler, 1876 (Meyer *et al.* 2004), *E. leucostictos* (Gmelin, 1790) (Lambkin and Knight 2007), *E. sylvester sylvester* Fabricius, 1793, *E. sylvester* form *doleschallii* C. & R.

Felder, 1859 and now *J. e. tristis*. These taxa are all robust and vagile and appear quite capable of traversing the distances from the two nearest land masses. Almost all the above taxa have been recorded during wet seasons, when monsoon winds predominantly blow from a northerly direction, and thus the specimens most likely originated from PNG, except perhaps *E. sylvester sylvester* Fabricius, 1793, which is endemic to Queensland (Braby 2000). Other taxa on Mer Island are also considered likely vagrants but are not discussed here.

In attempting to understand vagrancy in terms of classic quantitative island biogeography (MacArthur and Wilson 1967), Diamond (1975) used two key predictors for estimating the number of species that potentially could persist on an island, i.e. the number of species is relative to the size of an island and to its distance from a land mass that might serve as a key source of colonisation. On face value, when applying these predictors to the total number of butterfly taxa recorded from Mer, it seems that the classic island biogeographical theory does not hold true, i.e. Mer has a diverse fauna that is at odds with its relatively small size (including its two satellite islands Dauar and Waier) (Fig. 7), its remoteness from the two nearest large land masses and in comparison with the fauna of some Torres Strait islands that are close to mainlands. Rather, if one considers the number of potential vagrant species that have been recorded from the island and if the distances that the island lies from the two land masses are not significant barriers to vagile vagrant species, then the number of only resident butterfly taxa on Mer Island would be significantly lower than total species recorded. These residents might well be in equilibrium, i.e. between immigration and extinction rates, as expected from theory (Diamond 1975).

Mer Island was first sampled for butterflies during the first decade of the 20th Century by Hermann Elgner (Waterhouse and Lyell 1914, Dunn 2007). There was then a long hiatus until 1984, when Mer Island was 'rediscovered' and was considered a butterfly hotspot by butterfly workers in Australia (Wood 1987, Lambkin and Knight 1990). The island has continued to be a popular butterfly collecting location up until the present. A review of butterfly collection data from Mer indicates some anomalies regarding the temporal appearance and persistence of butterfly taxa on the island. One example is the Hamadryad butterfly, *Tellervo zoilus digulica* Hulstaert, 1924, which was unknown from the island prior to 1993, despite the intensive sampling of butterflies by many collectors over the latter part of the 1980s (Lambkin and Knight 1990). Then, in April 1993, *T. z. digulica* was reported as being common in rainforest areas on the island (Johnson *et al.* 1994) and, since then, has been observed on the island on a continual basis up until at least 2016, when the last known butterfly sampling was undertaken. Prior to 1993 it is very unlikely that the butterfly was present but not observed, considering the frequency and intensity of butterfly sampling undertaken (Lambkin and



Figs 6-7. Mer Island: (6) road on central plateau; monsoon vine forest (on left) and abandoned village gardens (on right); (7) Mer group of islands: Mer RHS at top, Waier RHS at bottom and Dauar LHS (southeastern aspect).

Knight 1990), in addition to the conspicuousness of this taxon; thus it can only be assumed that the butterfly is a relatively recent arrival on the island. In addition, Mer is an unusual location for *T. z. digulica* as the butterfly is a very distinctive race restricted to the southern lowlands near the Indonesian Papua Province/PNG border, i.e. on the Digul River in Papua and on the

Bensbach and Morehead Rivers in southwestern PNG (Fig. 5). Lambkin (2013) commented on *T. z. digulica* and considered its enigmatic distribution inclusive of Mer Island as strange. The two discrete areas in New Guinea where *T. z. digulica* occurs are approximately 350 km and 285 km northwest of Mer respectively (Ackery 1987) (Fig. 5). Clearly, the butterfly is now resident on Mer, where the hostplant is *Parsonsia velutina* R.Br. (Apocynaceae) (TAL unpublished data) and this population could well have resulted from vagrants blown onto the island in the early 1990s from one of these distant locations in southern New Guinea.

So how many butterflies are flying over expanses of water in Torres Strait? Kikkawa *et al.* (1981) thought that invasions of butterflies from PNG across Torres Strait occurred occasionally and that populations of butterflies might become temporarily established on islands and on the Queensland mainland. Based on the present survey of potential vagrants recorded on Mer Island and the movements of butterflies in Torres Strait reported by Lambkin (2016) and proposed by Kikkawa *et al.* (1981), there is now suitable evidence to suggest that a significant number of butterflies in Torres Strait do cross oceanic barriers and regularly arrive on islands, even those considered to be relatively remote.

Acknowledgements

I thank the local community council and island elders of Mer Island for allowing entry into their community on many occasions over several decades and for their assistance during my visits to the island. In addition, I thank my long-time comrade A. Ian Knight of Exton, Tasmania for his company during many visits to Torres Strait over the better part of four decades. A review of the first draft of the manuscript by M.P. Zalucki (University of Queensland) was greatly appreciated. This paper partially fulfils the requirements for a Master of Philosophy degree undertaken by the author at the University of Queensland, Brisbane.

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Book Review: continued from page 240

The latest comparable milestone in Australian entomology, once again an initiative of CSIRO's Australian National Insect Collection, is the 3-volume *Australian Beetles* series, a giant enterprise being coordinated by John Lawrence and Adam Ślipiński, respectively the previous and present curators of Coleoptera at ANIC. Volume 1 appeared in 2013 and was authored solely by Lawrence and Ślipiński. It gave the essential morphological introduction to the Order, provided a key to families for both adults and larvae, and gave a synoptic, mostly morphological, account of each family. It was liberally illustrated with colour photographs of live and pinned specimens, covering every family. Volume 2, which has just appeared under editorship of Ślipiński and Lawrence, takes the Australian Coleoptera a giant quantum leap further into understanding and accessibility by providing definitive accounts by 23 authorities from around the world of 36 families. Each family includes a key to genera and each genus is illustrated, no fewer than 1000 of them in colour, using the most modern photographic techniques with every leg and antenna moved to a symmetrical position. Each genus is separately reviewed under the headings of Type Species, Characteristics, Australian Species, Distribution, Biology and Key References.

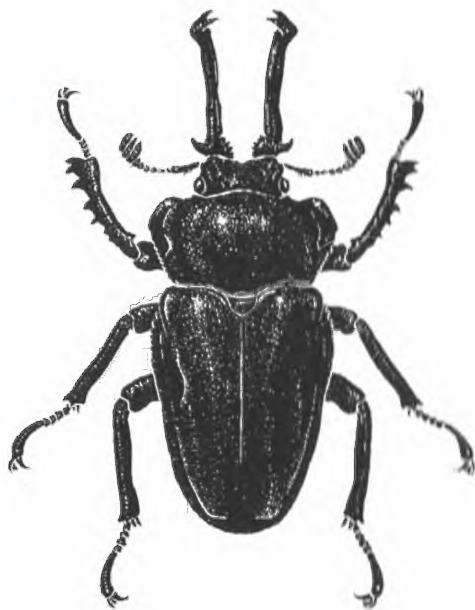
The book's coverage begins with the primitive families and proceeds through the major groups such as the carabids, both adephagan and polyphagan water beetles, all the scarab families, the buprestids and the tenebrionids. The book is dedicated to Martin Baehr, a prolific German carabidologist who spent his life working on the Australian fauna and co-authored with American Kipling Will the 157-page definitive chapter on the Carabidae, but sadly did not live to see it in print. The remaining families will be dealt with in Volume 3 which is under preparation.

The volumes are an expression of the ultimate stage of academic and intellectual synthesis of the Coleoptera. They may seem forbidding to the new class of amateur photographer naturalists whose images are creeping into thousands of websites, such as the Atlas of Living Australia, that were initially set up for serious scientific purpose. However, the simple fact that the volumes contain authoritative images of every genus means that a quick reference to them before posting images might prevent errors such as the lumpy rectangular weevil that is currently posted as the lumpy rectangular zopherid *Zopherosis georgii*, one of many, many such bloopers on ALA. Photographers: please buy and use these books!

A plea for the next volume. In the index please bold the page numbers for the main family and genus entries and italicise the pages for illustrations. The index for a 792 page book needs this to be useful.

Reviewed by Geoff Monteith

THE AUSTRALIAN ENTOMOLOGIST



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COVER

The Richmond Birdwing, *Ornithoptera richmondia* is the smallest member of its genus and the only *Ornithoptera* species found outside the tropics. It is endemic to southern Queensland and northern New South Wales. This female, seen at Mary Cairncross Scenic Reserve in the Sunshine Coast hinterland, is searching for a place to lay its eggs in the forest understorey near the entrance to the rainforest walk. It requires soft young growth of the vine *Pararistolochia praevenosa* and is more commonly seen high overhead in the subcanopy. The species is regarded as vulnerable and has been the target of a concerted community based recovery plan now managed by the Queensland Government Department of Environment and Science. Pen and ink drawing by *Australian Entomologist* contributor Dr Albert Orr, an award-winning author of illustrated butterfly and dragonfly books in Australia and overseas.

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